THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 43. Thursday, December 25, 1930. No. 749.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Telephone: Central 1885. Telegrams: CIRA.

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Foundry Technical Institute, Meek's Road, Falkirk *(Telephone 332)*

A Technical Stocktaking and the Future.

The present time, so far as grey-iron foundry practice is concerned, can be characterised as an era of alloying and heat-treatment. The first step, though of somewhat empirical a nature, was the introduction of the Perlit process, which combined the control of composition with the heat-treatment of the casting through mould-temperature control.

Piwowarsky was responsible for the introduction of superheating, which, too, is related to heat-treatment from a double angle, one being the presumed dissolution of graphite nuclei and the other a slower cooling due to the greater initial heat to be dispersed.

Then came the internationally-appreciated work of Hanson, Everest and Turner, which firmly established the use of nickel as an alloying addition to cast iron. During this period, privately-communicated results emanating from Poole, Young and Fletcher showed that cast iron was susceptible to heat-treatment and capable of giving extremely high tensile results, but unfortunately without the elongation to be associated with malleablising.

Another interesting series of experiments have been carried out by French scientists on case-treatment with various elements like zirconium, virtually an extension of Arnold's famous researches into the migration of elements in steel. The nitrogen-surface treatment of cast iron now being actively developed by Hurst is also along these lines, and represents one of the most promising fields for exploration. This worker, too, has recently published some exceedingly interesting work on heat-treating both simple and alloyed cast iron. Finally, molybdenum has been proved to be a suitable alloying element for cast iron.

In view of all these developments—superheating, composition control, mould-temperature regulating, alloy additions, heat-treatment and case-treatment—the founders have supplied themselves with weapons capable of rebutting successfully any charge of hibernation. As an industry, the great selling points for grey cast iron are: Cheapness relative to other metals and structures, rigidity, self-lubrication associated with wear, and dimensional accuracy—proof is available that well-made castings are better in this respect than drop forgings made in series.

If founders will take cognisance of these pointers, they will in a large measure arrest the inroads that are being made into their business by weldings and forgings.

Wringing Our Withers.

Sir Ernest Benn is well known for his strong views on national extravagance. He is a keen individualist with a strong sense of the value of capital and of personal effort in its accumulation. He believes in hard work and saving. He doesn't think the State should do anything for anybody, but that we should rely on ourselves and that we should enjoy freely the results of our own labours. By such individualism the greatness of England was built up and the nation cannot be greater than the sum total of its citizens. He has recently written a book called "Account Rendered 1900-1930," which is calculated to give anybody furiously to think. He points out that out of a population of forty to fifty million people virtually the whole of the enormous sums raised in direct taxation are paid by two million people. He deplores the new expenditure on education, because ambitious and intelligent people will find a way, by personal effort and sacrifice, to get what they want and that this very effort is calculated to bring out the strength of character the nation needs at this time.

In the book he points out that our public liabilities have multiplied no less than thirty times in as many years. The war increased our debt tenfold and now stands at seven thousand millions, involving us in an annual charge of three hundred and fifty millions. Yet he says that our post-war actions have landed posterity with a bill far heavier than the cost of the whole of the war.

A British child born in 1883 had a debt, national and local, of £18. To-day a child born has a debt of £500. Those who boast of the work we are doing for posterity may ponder on that fact. The cost of collection of taxes is three times as high as in 1917. In 1913, agricultural regulation cost us a quarter of a million a year. To-day the Ministry of Agriculture spends nearly three millions a year. Education in primary schools costs over two and a-half times the cost in 1913-14. In 1891 we spent twenty-five millions annually in social services, and in 1911 it had increased to sixty-eight millions. In 1927 this figure had increased to no less than three hundred and eighty-three millions. Is it not time that we got back to the simple basis of each according to his merits? Every increase in taxation is a tax on enterprise and ingenuity. Every increase hampers us in our adaptability to meet changing circumstances. We have even now the spectacle of some occupations so undermanned that those in them can afford to hold the community to ransom while those in other insured occupations unlikely ever to work in them again are living on unemployment pay.

The remedy is not beyond the traditional common sense of the British people.

XUM

Catalogues Received.

Safety Goggles.—We have received for inspection from Messrs. S. Pulzer & Son, Limited, 45, Hatton Garden, London, E.C.1, a pair of their latest design of fettlers' goggles. They weigh lighter than any other we have handled, whilst ventilation, associated with complete protection is afforded by gauge side-members. It is supplied with three types of nose bridge, having a convex conformation, which assures complete comfort. At the top of the two eye-pieces, a reinforcing bar has been introduced. The whole is collapsible, and when closed can be carried in a not too bulky light-weight box. The glass used is Willson's super-tough, which guarantees immunity from eye strain when worn over long periods. In many cases, these goggles are so generously designed that they can be worn over ordinary steel-frame spectacles, but special provision has been made by way of a cover-all contraption—a combination mask and goggle for those who find discomfort in wearing two pairs of glasses. The potentialities of the goggle under review are set out in a leaflet, which is available to our readers on application.

Furnace Goggles.—We have received from Messrs. J. & R. Fleming, Limited, of 136, Clerkenwell Road, London, E.C.1, some very interesting publicity matter dealing with furnace goggles, carrying Infrex lenses. This glass has been tested out at the National Physical Laboratory for both light and heat transmission with excellent results in both cases. Before the war, the average metallurgist learnt by some obscure means or other that ultra-violet and infra-red rays were dangerous to the sight, and, later, that the latter were harmless to sight. Now it appears that the infra-red, as heat rays, may cause cataract. Periodically, we try to drill into those in charge of melting furnaces that, from the optical point of view, cobalt-blue glasses are about as much use as a sick headache (and, indeed, may cause one), but we still see them in very common use. Being practical, we realise the difficulty of change, because melters will refuse to take responsibility for casting temperature with change of glass. We do plead, however, with all the force at our command, for the provision of modern optically-correct glasses to be placed at the disposal of new entrants to the melting industry. To the manufacturers of goggles, we ask them to take into consideration the necessity for the exclusion of a great quantity of light, otherwise melters cannot see the back wall of the furnace, evaluate slag and flame conditions, and take cognisance of other guides to correct melting and furnace upkeep. Whilst on this subject, may we warn those working around a furnace not to gaze at the little flames playing around doors and crevices. Messrs. Fleming, Limited, by the way, will send a pair of goggles fitted with Infrex glass to interested parties.

Notes from I.B.F. Branches.

Newcastle.—Mr. J. W. Eckford, of Craigie Lea, Tynedale Avenue, Monkseaton, has been appointed as Assistant Honorary Secretary of the local Branch.

Mr. R. J. Shaw, of Monkseaton (Past-President of the London Branch and Junior Vice-President of the Newcastle Branch), has been appointed as representative on the General Council in place of Mr. Victor Stobie, who now takes his seat on the General Council in virtue of his election as Junior Vice-President of the Institute at the last Annual Meeting.

A flux for tinning can be made from 59 per cent. ammonium chloride, 40 per cent. zinc chloride and 1 per cent. sodium fluoride. This flux is hygroscopic, so it should be kept in a stoppered bottle.

I.B.F. Branch-Presidents.

No. 5.—EAST MIDLANDS BRANCH.

Mr. T. Goodwin was born at Staveley, in Derbyshire, about 50 years ago, and served his apprenticeship in the foundries of the Staveley Coal & Iron Company, near Chesterfield, then under the management of the Markhams. His father at that time controlled the whole of the pipe-making plant.

As was the custom of the moulder three decades ago, he sought a wider experience of the foundry trade in the towns of Chesterfield, Sheffield and Nottingham before settling down in Derby as foundry foreman at the engineering works of Messrs. Simkiss & Knighton. In 1914 he joined the firm of Andrew Handyside & Company, Limited, of Derby, serving as foundry foreman, foundry manager and then as works manager.

In 1926 Mr. Goodwin was appointed works manager to the Wycliffe Foundry Company,

Mr. T. Goodwin.

Limited, malleable ironfounders, of Lutterworth, near Rugby, and shortly after his appointment the company commenced the development of an entirely new process for manufacturing malleable-steel and malleable-iron castings. This process proved very successful, and the extremely high quality of the castings produced resulted in an increased demand for the company's products.

He joined the East Midlands Branch of the Institute of British Foundrymen shortly after its inception, and has been a member of the Branch Council for the greater part of that period since its formation. He was for two years Junior Vice-President and for one year Senior Vice-President. He took an active part in the Leicester Convention of the Institute and also in the entertainment of the American guests when they were in the East Midlands area.

When screwing Monel metal, as a lubricant use a thin mixture of red lead and machine oil. This will adhere to the cutting edges of the threading tools.

Stainless steel can be polished by a cotton buffing wheel using a surface speed of 10,000 to 15,000 ft. per min. Use Turkish emery as an abrasive and lubricate with tallow or lard oil.

Random Shots.

I take this opportunity of wishing all readers of The Foundry Trade Journal a very happy Christmas and a successful New Year. To all, including the highbrows who have neither taste nor time for this column; the mezzobrows who can pick the plums from the chaff, if I may addle the metaphor; the lowbrows who frankly revel in a little comic relief from the serious round; and the broadbrows, a still more numerous class, who realise that humour, either as a spice or as a salt, has a very important place in life, I wish a more prosperous 1931 than 1930 proved to be.

* * *

The superstitious may note that the digits of 1930 and up to the fatal thirteen, and conclude that with the advent of 1931 we shall really turn the corner.

* * *

A few new stories may be seasonable at this time of the year. They concern an Austrian general, Von Galgotzy, who has just died. He was famous for his sarcastic tongue and for being the worst-dressed man in the Austrian Army. He once attended, without proper uniform, an official dinner at which full dress was obligatory, and the host, seeing a chance to score off the general, suggested that he should return home and change. He did so, and at dinner dipped the sleeve of his gold-embroidered tunic in the soup. He said, loudly, by way of explanation, "I am letting my uniform dine. It was my uniform they invited, not me."

* * *

He used to say that only tailor-made officers wore tailor-made uniforms, and on taking a job as commander in Bosnia he wired a ready-to-wear firm in Vienna, "Send immediately two uniforms for a medium-sized general." He was given 10,000 gulden by the War Ministry to build a bridge over an unpronounceable river (the Trebentshitza). He built the bridge, but failed to return his accounts. At last he wired, "Received 10,000, spent 7,300, am returning 2,700." The War Ministry wanted a detailed statement for the 7,300, and he wired, finally, "Received 10,000, spent 7,300, am sending back 2,700. Anyone who doesn't believe it is an ass." The Emperor Franz Josef, who was asked to punish him for insubordination, merely said, "But I believe it."

* * *

In Bosnia his troops suffered through having to carry water up the mountains to the fortresses in buckets. He telegraphed for mules, but they were refused through lack of funds. A few weeks later a colonel arrived on a tour of inspection. Before going to the mountain camp, the general said, "Let's give the troops a pleasant surprise. The poor boys are suffering from lack of water. Let's each carry up a bucket." They each did so, in the burning sun, up the mountain side. The colonel desired to rest, but Galgotzy insisted on carrying on, and, when the colonel collapsed, said, "Don't you think the troops should have those mules?" He got them.

* * *

He bluntly called a high officer an ass, and was ordered publicly to apologise. He donned parade uniform and saluted the officer before the troops, saying, "I'm sorry I called you an ass." Later he met his victim outside the casino and reiterated his apology, but added, "But I think you made a mistake in calling for a public retraction." "Why?" asked the officer. Galgotzy replied, "Because until to-day only you and I knew I thought you were an ass. Now the whole army knows it."

Marksman.

Heat-Treatment of Cast Iron.

SUCCESSFUL INDUSTRIAL APPLICATIONS.

The first business meeting of the Sheffield and District Section of the Institute of British Foundrymen was held at the Albany Hotel, Sheffield, on Friday, November 21, when MR. J. E. HURST, of the Sheepbridge Stokes Centrifugal Castings Company, Limited, of Chesterfield, read a Paper on "Oil-Hardening and Air-Hardening Cast Iron." The full text of the Paper appeared in THE FOUNDRY TRADE JOURNAL of December 4. The Hon. J. M. W. North (Branch-President) occupied the chair.

DISCUSSION.

The CHAIRMAN (the Hon. J. M. W. North) said that Mr. Hurst must have taken a great deal of trouble to obtain the results he had, and one could realise how keen he was to benefit the cast-iron industry, particularly by publishing the results of the original work he had done. The lecturer had mentioned how important it was to do everything they could to increase the usefulness of cast iron, especially in these times, when, unfortunately, the cast-iron industry was no better than many others. He (the speaker) came across an example recently where certain castings used as boxes and casings for wireless work and electrical mechanism that had originally been made in cast iron were now prohibited by the Government on account of their not having sufficient elasticity if an explosion occurred. Mr. Hurst's remarks might produce very beneficial results in obtaining cast iron to comply with all the necessary requirements. As they were aware, the British Cast Iron Research Association was doing good work, and he expected that many of those present had been helped to some extent by that Association. Nevertheless, it was very important that each one of them should do all he could in his own works to forward research work in his particular line. They could not leave all that work to the Association and sit down and wait for results. They ought to go ahead and do their own research work as much as they could afford. Mr. Hurst had mentioned the difficulty he had experienced in adding nickel to cast iron. He (the speaker) had always understood that the best way to add nickel was to add it in the form of shot or sheet in the stream of the metal coming from the cupola spout into the ladle, so that the nickel fell into the stream and was taken into the ladle. The drawing of it into the ladle took it right down and mixed it well. He did not know if Mr. Hurst had tried that method. If he had it was hoped that he would tell them what result he had obtained. Perhaps also Mr. Hurst would tell them the method of adding chromium. Also the time taken for hardening the castings and the time the material was in the furnace. He wondered, moreover, if there was any chill in the castings in the as-cast condition before they were hardened or tempered.

Methods of Adding Nickel.

MR. J. E. HURST, in reply, said that concerning the adding of nickel "F" shot to the stream of metal coming from the cupola he had found the method quite unsatisfactory, and apparently no amount of agitation seemed to eliminate the undissolved particles. Even sieving the shot and using the finest grades only, failed to overcome the difficulty. In the case of the experiments they had added nickel in the form of very thin foil, but it was far better to add it as ferro-nickel in the cupola, or, even better still, to use a pig-iron guaranteed to contain the amount of nickel that was required. This latter method was to be recommended in all cases where the composition of the final metal was required to be accurate. In regard to the addition of chromium, in all cases it was added by using a pig-iron containing the required amount. In his experience this was the most preferable way of making the alloy additions. In answer to the question about the time taken for hardening the material, he would say that the total time taken in raising from normal to hardening temperature was about ten minutes. In no case was there any chill in the as-cast condition.

Losses in Slag.

MR. G. OXLEY said that Mr. Hurst's experience in regard to the addition of nickel and chromium was similar to his own. The first time they tried to add nickel and chromium to cast iron they added it in a stream in the spout. When he had the iron analysed he found that he was losing a serious amount. Then they tried putting it on the cupola in ferro-chrome and ferro-nickel, in small ingot form. In some cases they got a very good percentage of chrome and nickel, but with other castings melted in the same heat they found they had practically none or very little. He did not know if he was right, but he contended that if they got a nickel or chrome near the limestone in the charge it was apt to be carried away in the slag through the slag hole. All the experiments of oil- and air-hardening described by the lecturer had been on cylinders or castings of a uniform thickness. He would like Mr. Hurst to tell them the effect on castings that were not uniform.

MR. HURST said that, in respect of the addition of ferro-nickel and ferro-chromium to the cupola, he really could not say whether Mr. Oxley's explanation of the reason for the loss was correct. He was rather of the opinion that the concentrated form caused unequal distribution. He thought that the safest and best way for anybody making nickel additions was to make sure that they were in the original pig-iron. So far as castings of non-uniform thickness were concerned, he was afraid that up to the time of writing the Paper he had very little experience. He quite appreciated that there might be difficulties with material of non-uniform thickness just as there were difficulties with articles of non-uniform thickness in the hardening of steel. All his experiments had been conducted on castings of uniform, or approximately uniform, thickness. Alloy steels, for example, were by no means free from the difficulties occasioned by quenching of articles of non-uniform thickness, so that cast iron was not alone in that respect.

MR. OXLEY said that in regard to the loss in the chrome he had found no difficulty if it was kept away from the limestone. The trouble arose through it being put on in the charge near the limestone. They had lost a great deal in that way and he thought it was carried away in the slag.

MR. HURST: Very likely; I am not denying it.

"F" Shot Found Satisfactory.

MR. J. ROXBURGH, speaking of the addition of nickel, said that from the experience of his foundry he thought that the method to be used depended upon the amount of nickel one required to add and also on the amount of metal in the ladle. The "F" shot, he understood, contained about 6 per cent. of silicon, which materially reduced its melting point. In one instance they had 7 or 8 tons in the ladle, and poured the nickel, as shot, and previously heated, into the stream and experienced no difficulty whatever in introducing 0.75 per cent. Ni, but for smaller quantities of metal he would advocate the use of nickel ingot charged in the cupola. In regard to chromium, they added it in the cupola in the form of ferro-chrome (70 per cent.), and generally allowed for about 10 per cent. loss. Almost invariably they could introduce the amounts of both nickel and chromium desired. In regard to the three samples that Mr. Hurst had selected for his examinations, it was interesting to note that in each case the combined carbon was approximately the same, yet, on the other hand, the first sample quoted by Mr. Hurst contained 0.44 per cent. of chrome and 1.32 per cent. of nickel, a ratio of 3 to 1. The second sample contained 0.95 per cent. chrome and 2.56 per cent. nickel, and the third sample 0.61 per cent. chrome and 3.37 per cent. nickel—the carbon, silicon and manganese being approximately the same. He would like Mr. Hurst's views on this point, viz., that he had obtained the same combined carbon, although the irons contained different ratios of nickel to chromium. Also it was interesting to note that, in the third sample referred to, where the ratio was 5 to 1, neither the tensile test nor the Brinell hardness tests were increased. This implied that with low chromium (0.44 per cent.) and 1.32 per cent. nickel they could get the same results as with 0.6 per cent. chrome and 3.37 per cent. nickel.

This latter was a very expensive mixture. He personally, however, would have thought that with the high percentage of nickel, viz., 3.37, the properties would have improved by the fact that such metal would have lent itself better to heat-treatment.

Relative Ratio of Elements Important.

MR. HURST said that he had little experience of the addition of nickel in such large quantities as were alluded to by Mr. Roxburgh, and probably Mr. Roxburgh's experiences were quite special. In any case, the average casting they were called upon to make was quite a small one, and the addition of nickel in the condition of "F" shot was found to be definitely unsatisfactory. In regard to the point raised by Mr. Roxburgh on the ratios of chromium, combined carbon and nickel, he was not sure what was in his mind. His (the speaker's) experience was probably not sufficient for him to say whether Mr. Roxburgh was correct in anticipating that there was some special significance in any ratio of carbon, chromium or nickel. The fact remained that the three analyses had been checked by two or three different authorities and were the mean of the results obtained by those authorities. The maximum and minimum results obtained varied very little, and he was really unable to give any explanation as to why there should be any greater difference in combined carbon. As to the point raised by Mr. Roxburgh, that he would have expected some alterations in the properties in the as-cast condition in the sample containing over 3 per cent. nickel, he did not know what his (Mr. Roxburgh's) experience was in that direction, but their experience was that there was very little alteration in properties with over 3 per cent. nickel, and he agreed with Mr. Roxburgh that lower nickel contents could be used with advantage. He believed, in fact, that it was quite possible to dispense with the nickel altogether. They had had experience to show that it did not matter whether or not nickel was used. Whether his experience was identical with that of Mr. Roxburgh he did not know, but it was an actual fact that the addition of even 4 per cent. of nickel, providing it was with a grey casting, was accompanied by very little change in hardness or tensile-strength properties.

Influence of Mass.

MR. A. FIRTH asked if the method of tempering and hardening adopted by Mr. Hurst would be applicable to larger castings at all.

MR. HURST: I have had no experience.

MR. FIRTH: In the castings of larger size, would it be commercially practicable to deal with them by this method?

MR. HURST replied that, so far as cylinder liners for motors were concerned, it was a commercial process, and had been for some time. It had been definitely commercial, and castings

had been made for probably a period of about two years. So far he had not had any experience in regard to large castings. Of course, experimental work would be necessary, but he could see no reason why certain types of castings, at any rate, should not be successfully treated.

Mr. Firth: One that I have in mind was about 15 in. in dia., 5 in. or 6 in. deep and ¾ in. thick.

Mr. Hurst: That sounds a reasonable proposition to deal with. Immediately greater thickness is involved, one is likely to experience trouble. In the case of steel, it is difficult to get the hardening to penetrate to any considerable depth, and one is liable to develop internal stresses which, in a brittle material like cast iron, would cause the collapse of the article.

Commercial Application.

Mr. T. R. Twigger said that the commercial practicability of the process in regard to cylinder liners for motor-cars had been recognised and taken advantage of for quite two years. The principal difficulty which had been met with was the elimination of distortion. Some liners were particularly thin, and exceptional care was necessary to avoid excessive change of shape during hardening, which meant an excessive amount of grinding to the finished bore after pressing the liner in the cylinder. In his firm's experience of hardening cylinder liners they had evolved a patented method of eliminating any excessive distortion, and several thousand liners have been produced by this process and supplied to various commercial-vehicle manufacturers during the past twelve months.

Mr. Wood observed that Mr. Hurst had told them about the process of machining cylinder liners prior to or during the hardening of them. Could he give them some idea as to whether the machining could be applied to straight cast iron in the as-cast condition or to straight moulds containing nickel or chromium? He wondered whether, in such a case, it would be too hard to machine.

Machinability.

Mr. Hurst replied that he had very little experience of material other than centrifugal material, but he did not anticipate that the difference would be very great so far as the machining properties were concerned. So far as he knew there was very little difference in the industrial application of the process to cylinder liners. The oil-hardening and tempering were carried out after a certain amount of machining had been done on the liners, and it depended very much on the Brinell hardness to which they were tempered as to whether they could be machined after hardening. Generally speaking, it could be taken that the machining properties of the liners were comparable with the average for cast iron.

Mr. E. J. Brown remarked that Mr. Hurst had taken a temperature of 850 deg. C. for hardening in the experiments he had addressed them upon. He wondered if it would not have been better had he taken a lower temperature. He (the speaker) understood that the best hardening results, taking into account elasticity, were obtained by tempering just above the critical range.

Mr. Hurst: Yes, probably that is the case. I want you to appreciate that I have only selected three results from a whole series of experiments just to demonstrate the effect. I am not suggesting that these are by any means the best results that can be obtained. On the contrary, I would like it to be thought that they were the worst results obtainable and that it would be possible to do much better.

Mr. Wharton said it would be a very difficult thing to machine castings at a much higher Brinell hardness than 400. In his experience of the centrifugal processes he found that the Brinell hardness varied considerably over the thickness of the ring. In some cases there was a decided skin hardness. They might have a range of 30 or 40 points of Brinell hardness in one sample. It was very difficult to remove that skin hardness from, say, the outside of a cylinder. Then he would like to ask Mr. Hurst if he was at liberty to disclose what his casting temperature would be in the case of alloys of the type made under the process he had described. Then, too, he would like some more information about the machine that he used for his ring testing, which was not the simple thing it might appear to be from Mr. Hurst's remarks. It was a difficult thing to get really accurate results of ring testing.

Mr. Hurst said that if he conveyed the impression that the machining of cast iron at 500 Brinell was easy he had been guilty of an error. What he had intended to show was that it would be necessary to grind cast iron at 500 Brinell. In regard to variation in Brinell hardness he had taken the precaution in the experiments of ascertaining the average. In regard to the casting temperature he did not know that he had any really accurate data, but he imagined that it was about 1,250 to 1,350 deg. C. The machine he had used for ring testing was one of Avery's, specially built for the purpose.

Mr. Roxburgh inquired as to what kind of oil was used for quenching and also whether Mr. Hurst had had any experience in regard to the hardening of chill castings.

Mr. Hurst replied that he did not know if Mr. Roxburgh really wanted him to answer his second question. Whatever experience he had had of hardening chilled castings Mr. Roxburgh knew all about. The kind of oil used was whale oil.

Mr. Hurst was accorded a vote of thanks on the proposition of Mr. Roxburgh, seconded by Mr. Brown.

Modern Centrifugal Dust Collectors.

From Our Engineering Correspondent.

During the past two or three years a great advance has been made in the science of dust separation, using patent collectors operating on the centrifugal and gravity principle, in conjunction with a fan. This is a matter of outstanding importance for foundry and similar work, for example, in connection with the operation of sand-blast cabinets and rumblers, and the main pioneers in this field are Davidson & Company, Limited, of Belfast, well known for the "Sirocco" fan, who several years ago perfected their centrifugal dust collector after extensive laboratory and large-scale experimental work. Already they have nearly 1,000 collectors at work, including over 500 upon boiler plants, separating the dust from chimney gases, an extremely difficult problem because of the huge volumes of gas that have to be handled. Also the efficiency now obtained is such that 70 to 95 per cent. of the dust in air or gases can be collected, irrespective of varying dust concentration, as well as the volume of air or gases.

Three general types of these collectors are supplied, that is the "D" (Direct), the "SP" (Shunt Pressure) and the "SS" (Shun Suction), but the basic principle is the same. The "D" type, for example, of which the other two are modifications, consists of a horizontal casing, of volute shape, into which passes, by fan suction, all the dust-ladened air or gases travelling round at high velocity. As a result, the heavier dust is thrown to the outside by centrifugal force, while, because of the volute shape, this pronounced separating action gradually increases as the radius of the casing diminishes. From the top the dust-free air or gases pass out by a trunk leading to the fan suction, which discharges to the atmosphere, while at the bottom of the volute casing is a large-diameter conical outlet, terminating in a vertical conical trunking of considerable height, leading to a closed dust receiver. The action on the dust particles is also that of gravity, aided further by the conical shape of the bottom of the casing, as well as centrifugal force, the particles being continuously urged downwards as well as outwards in a spiral direction, aided by the action of the lower cones. Alternatively, the fan can discharge the dust-laden gases into the collector, which in this case has the outlet to the atmosphere.

Over 400 collectors of this type are now operating, apart from boiler plants, in all kinds of industries under the most varied conditions, as regards the nature and amount of the dust, and the temperature, velocity and general quality of the air or gases. Thus some typical applications, in addition to foundry work, are cork grinding in the linoleum industry, emery wheels, the enamelling of baths, cigarette-making machines, woodworking machinery, cement manufacture, coal screening, cotton-seed cleaning machines, blast-furnace gas, buffing and polishing machines, pulverised-fuel plants, stone grinding and many operations in the chemical and allied industries.

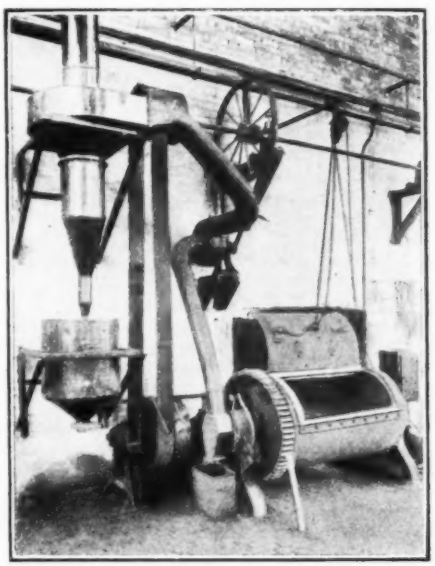

Fig. 1.—"Sirocco" Dust Collector applied to Rumbler.

In boiler-plant work the results are of a striking character, and the 500 collectors are recovering about 150,000 tons of dust per annum. Practical experience obtained with about 350 collectors in 75 British power stations shows that dust, to the extent of 0.50 to 5.00 per cent. on the weight of the coal, is passing out of the chimney with hand and mechanical firing, and as much as 15 per cent. with pulverised fuel, and the collectors are separating 70 to 95 per cent. of the amount, while coke, and particularly coke breeze, are worse in this respect than coal.

Lord Kirkley, the leader of the recent trade mission to South Africa, on December 19, disclosed some of the conclusions and recommendations which the members of the mission propose to make in their report. This country, said Lord Kirkley, was failing to maintain its proportion of the trade with the Union of South Africa. Its share had fallen from 56 per cent. of the total Union imports to about 46 per cent. A portion of the report would probably arouse some measure of hostility among manufacturers and exporters. It was that which contained a series of criticisms of British manufacturing adaptability and of shortcomings in the field of salesmanship. To increase our trade, the first step must be to improve our sales organisation with a view to winning trade in those spheres in which, instead of advancing *pari passu* with our competitors, we had remained stationary.

Scottish Founders' Annual Banquet.

PROMINENT INDUSTRIALISTS ON TECHNICAL CO-OPERATION.

The annual dinner of the Scottish Branch of the Institute of British Foundrymen was held in the Grosvenor Restaurant, Glasgow, on December 6. Mr. James Miller, Branch-President, presided, and was supported by Bailie Ninian MacWhannell (representing the Lord Provost), Mr. F. P. Wilson (President of the Institute), Hon. J. Kenneth Weir, Mr. A. Harley (Vice-President of the Institute), Mr. M. M'Manus, M.B.E., Prof. A. L. Mellanby, Mr. E. Bruce Ball, Mr. H. Critchley, M.I.M.E., the Town Chamberlain of Falkirk, the Presidents of local sections of Institution of Mechanical Engineers, Iron and Steel Institute, Institute of Metals, and other kindred societies, Mr. P. W. Thomas (Secretary of the Institute of Engineers and Shipbuilders) and Mr. T. Makemson (General Secretary of the Institute).

The loyal toasts were given from the chair, and received with musical honours.

The Secretary read apologies from Mr. Arthur Henderson, P.C. (Foreign Secretary), Mr. Tom Johnson (Under-Secretary for Scotland), Sir Robert Horne, Sir James Lithgow and others.

Glasgow as an Industrial Centre.

Mr. A. Harley (Senior Vice-President of the Institute), in proposing the toast of the "City and Corporation of Glasgow," said that it was a great honour to propose prosperity to the City of Glasgow, as he himself was a Scotsman, and, more, he was a "Falkirk Bairn." He first wished to say what a great pleasure it was to be in Glasgow and to meet so many brother Scots, and how much he was stimulated by their cheery spirits and listening to the dear old accents. The Scotch accent was to him like a breath of the Broomilaw. He was very proud of the Doric, and although he could not use it on all occasions nowhere was there so much musical and poetical expression as in the Doric of Auld Scotland. He claimed to be a native of the most historic county in Scotland, and in his opinion the characteristic qualities of Scots, warmheartedness and friendliness were typical of Glasgow folk. To the stranger they gave of their very best, and gave freely.

He was proud of the privilege of proposing the toast of the City of Glasgow, which had within its boundaries a not inconsiderable part of the population of Scotland; the prosperity of the city was therefore vital to the whole realm. He felt tempted to be reminiscent; as a boy a visit to Glasgow for a day was looked forward to as a great occasion—it was never Edinburgh—perhaps because the fare was more—but there was more stir in Glasgow. Looking at monuments was a dreich way of spending a holiday, but in Glasgow they were all together in one square and they could all be looked at in one glance. It was over thirty years since he crossed the border, so that his knowledge of the city might not be quite up to date, but he thought that apart from the cathedral there were no very historical buildings. There was the University, famous for its eminent teachers, some of them, such as Lord Kelvin, pre-eminent, and some who have gone forth to hold higher positions. The water supply of the city is unrivalled, although he had heard it stated that it was a pity more of it was not drunk. Glasgow was making meritorious efforts to clear those slum areas which were a mark on its fair name, whilst its transport reputation was known all over the world. He believed that the civic authorities were alive to every improvement, and were at present considering the oil-driven vehicle to reduce the noise in the streets. They would all agree that municipal matters were of the greatest importance as affecting the good government of the city. They had been fortunate in the men who had served the community in this respect. He was not one of those people who thought that a great corporation had no soul. He thought that in regard to the social services perhaps they should go slow or even call a halt at the present time, as the cost would fall heavily on the industries. Too much public assistance was already evident, and he regretted that it should be so.

Early Engineering Feats.

The City was suffering from the universal depression which presently exists, but it would not do to be pessimistic. There was no doubt that the tide would turn, but it would not be by a policy of waiting; a real forward policy must be planned. They needed more of the old pioneer spirit. He had been intensely interested in studying the early history of steam navigation. This year was the centenary of Henry Bell, whose "Comet" was the first steam-driven vessel to prove the commercial possibilities. But earlier than the "Comet" there was Symington's "Charlotte Dundas," built and launched at Grangemouth, which ran for two years on the Forth and Clyde Canal. But even earlier than that a vessel was built at Carron Works with a steam engine designed by William Symington. It was, of course, from that vessel that Symington perfected his plans for building the "Charlotte Dundas." A great engineering triumph; a forerunner of the great floating palaces with which they were now so familiar. Glasgow could still build those leviathans of wondrous beauty and symmetry of form. The modern liner was the most characteristic product of the present age. It was gratifying to know that one of the great new Cunarders was being built on the Clyde at Glasgow, but he sometimes wondered if many more of these gigantic vessels would be laid down. Had we not reached that stage when Glasgow must put its house in order and take the foremost place in the conquest of the air by the building of large air liners on a commercial basis? There was a motto in one of the class rooms of a Scots University which heads: "Good is this strife for mortals." The restoration of our industrial supremacy is a stern contest, and in Scotland, Glasgow must lead the way. He could not think she was losing faith in her destiny, but would bend to that task with the will to achieve.

As they had seen, that was the cradle of steam navigation. Why should it not be the cradle of commercial air navigation, and thus make "Glasgow Flourish"?

Surely the qualities for which the race was famous had not died out—the thirst for knowledge and the determination to succeed by practical application, hard work and thrift. What Glasgow needed to-day was not politicians. Those gentlemen were simply in a state of fatuous bewilderment. We needed a few men of real genius in the industrial sphere to bring in that new industrial era. It was such men who were the real benefactors of a community; the men who step out from the ranks to create new industries or revolutionise old ones, men who have an inborn passion for invention and the application of technical science to the making of things, whether it is a great liner or only a better kitchen range. That was the real romance of trade, and it was from the efforts of such men that streams of blessing flow out towards the whole community. He believed that Glasgow could produce such men; men who would write another shining page in the industrial history of that great City. He coupled with the toast the name of Bailie MacWhannell.

Electricity from Waste.

Bailie MacWhannell, in replying, said that he had first to apologise for the absence of the Lord Provost, who unfortunately had another engagement, but he had asked him to act as his substitute. The toast of the City was sometimes a very difficult one to reply to, but Mr. Harley had made it very easy in some respects, and had proposed the toast in a very happy vein.

He had referred to the monuments in George Square and the advantages of having them all in one place. There were some people who wanted to shift them all over the place, but he thought that they were just as well left where they were, and agreed that one look at them was enough. He thought that there were a number of the monuments of people who were quite forgotten and of no interest to anyone, which should be removed altogether. Mr. Harley had criticised the corporation very slightly, and he himself was always very sympathetic to criticism if it was constructive; the corporation appreciated such criticism. Last year Glasgow generated 32 millions of electrical units, 28 millions of which they handed over to the electricity department. That was what they got out of rubbish. The Govan plant was the largest of its kind in the country, and he believed the best of its kind. They did try to make a little progress in Glasgow. Mr. Harley had said that too much public assistance was given, and he agreed that that was the case. They were, however, making strong efforts to keep down capital expenditure, and to do as little as possible in the hope that they might be able to reduce the rates. He thanked them for the manner in which the toast had been proposed and honoured.

How Co-operation Helps.

Mr. N. M'Manus, M.B.E. (Branch Vice-President), in proposing the toast of "Kindred Institutions," said he understood that it was one of the duties of the Vice-President of the branch to propose this toast, and he did it with some diffidence, as they had present with them gentlemen representative of the engineering, iron and steel, non-ferrous and commercial interests of the district. These gentlemen were connected with societies which had objects very closely allied to the foundry industry, for did not the engineer make the designs from which the foundryman had to work, specify the materials that they should use, and stipulate the tests that their castings must pass? He wished that the engineer in the designing of the patterns could adopt a better proportion between the use of the compasses and the square and facilitate the work of the foundry. Progress was being made due to the efforts of the various institutes; for instance, a few years ago it was difficult to buy pig-iron to an exact analysis, but to-day it was quite common, thus showing that the Iron and Steel Institute members were doing useful work. To the Institute of Metals they looked for the non-ferrous metals for their use. These examples showed the kinships with their own Institute, and he asked them to drink the toast of Kindred Institutions.

Better Castings than Ever.

Mr. E. Bruce Ball, in responding, said it was with the greatest pleasure that he replied to the toast. It was always a pleasure to have the opportunity of meeting with members of other institutions, especially in Glasgow, where such friendly relations and so much co-operation existed. They issued each year a joint syllabus, and had for many years an arrangement by which members of any one society could attend meetings of any of the others. They were thus enabled to enjoy seeing the point of view of the other man. He was quite sure that all the institutions were doing excellent work, and that the country would never have obtained the position which it had without the technical institutions. The Institute was comparatively young, but had already done some excellent work in

furthering the production of better and more intricate castings. The formation of the Cast Iron Research Association alone was something to be proud of, as research was a necessity. The Institution of Mechanical Engineers also spent large sums of money on research. He would like to refer to the marine Diesel trials as of particular interest, and they had with them Professor Mellanby, who had had much to do with the carrying out of those trials, as the results showed that the Clyde can hold its own in marine Diesel work. It was the duty of every member of the technical institutions to see that the young men, as they grew up, should join those institutions. He thanked them on behalf of the Institution of Mechanical Engineers and all the other technical institutions. They were all doing good work, and they were proud of them.

Mr. P. W. Thomas, who also replied, said that he was only a deputy, and wished that his President, Sir James Lithgow, had been able to be present. That was one of the first opportunities that he had had of meeting the members of other institutions. He thought that it was very important, when things were so depressed as they were at the present time, for the various institutions to join forces. He hoped soon to have the pleasure of asking the members of the Institute to join with the Institution of Engineers and Shipbuilders in discussing a subject of mutual interest. He hoped that it would be the first of a series of meetings which would prove of great value to both institutions. On behalf of the Institution of Engineers and Shipbuilders he wished them all success, and expressed the hope that they would thrive alongside his own institute.

Taxation and Industry.

The Hon. J. Kenneth Weir, in proposing the toast of "The Institute of British Foundrymen," said that Mr. Harley had alluded to politicians as having bewildered minds. He was afraid that his mind at the moment was somewhat bewildered, and he rose with some diffidence to propose the toast, because he remembered that it was not so very long ago that he was working in a foundry without even having qualified sufficiently to join the Institute. Since then, however, he had had other things to do, but, looking back, there was no part of his training which he enjoyed more than that spent in the foundry. Mr. Harley had also made reference to the improvement in the affairs of the town and industry. If he might be permitted to be personal for a moment, he wished to say that he had gone into the Town Council with an understanding of both sides, and thought that the affairs of industry demanded first attention. He intended to keep the affairs of industry before his colleagues in the Council, because the taxation fell heavily on industry. The times were bad, but the present was the time to prepare for the good times in the future, and such institutes as theirs could assist to a very large degree. The Institute was of much value in showing the methods by which the cost could be cut down and the quality of the castings increased. He had, therefore, the greatest pleasure in proposing the toast and wishing the Institute all prosperity.

Work of the Technical Committees.

Mr. F. P. Wilson (President of the Institute), in replying, said that he thanked them on behalf of the Institute for the cordial manner in which the toast had been received. In view of the remarks of the proposer and what had been previously said by the Bailie he thought that it was evident that in Glasgow they had the type of men they all wanted to see in a Town Council. Men of business capacity were needed. He felt it was a great honour to meet a Scotch audience for the first time in his life. In the foundry when a solid casting was wanted they applied a chill, but he had received a solid reception without the use of any chill. He thought that on such occasions it was not necessary to go very deeply into foundry methods, but it was better to think of what the Prince of Wales said recently of scientific institutions. They got confidence through meeting together; they would miss a very great deal without their meetings, as they made contact, and contact was as great a factor as anything which they could get by the reading of books. Meetings such as those, over the national beverage, let them get closer together, and they exchanged little confidences which helped so much in our national life. He would like to refer to the recent formation of the Technical Committee. The Council felt that simply conducting the affairs of the Institute was not enough, and when they had so many expert people amongst the members it was time that they were encouraged to do something in their special line. The Technical Committee had been formed with five sub-committees dealing with cast iron, steel, malleable castings, non-ferrous metals and sand. The first duty of the sub-committees was the collection of specifications appertaining to these materials. He supposed that all foundrymen had experienced working to more than one specification and faced with the problem of getting from the cupola metal to satisfy several sets of tests. The Committee would collect the data and see if some co-ordination between them was possible, something of the kind of work that the B.E.S.A. was doing. He thought that they should be able to do something to lead up to B.E.S.A., whose influence was greater in carrying forward recommendations. Like the Research Association, they would work together and lead up to the work which those bodies should do. The Technical Committee, he believed, would lead to greater scientific applications in the foundry. The work of the Institute was increasing, and that was all the more reason why they should be proud of it and its work and do their utmost to increase its influence. He had the feeling that his reply had been somewhat poor and inadequate and almost as defective as some of the castings they made. In the foundry they applied iron cement to hide the defects, and he trusted that the kind reception they had accorded him might be used as the cement to repair the defects in his remarks.

Branch Activities.

Mr. Tom Makemson, proposing "The Scottish Branch," said that in the course of visiting the various Branches he had discovered that each Branch thought that it was the most important in the Institute, but as he did not like making comparisons he declined to express an opinion as to the relative positions of the Branches. There was one thing which struck anyone actively engaged in the working of the Institute, and that was the enormous amount of work done by its members in their own time and at their own expense. The Institute differed from most other technical institutes inasmuch as the Branches had not sprung from the Institute so much as the Institute had sprung from the Branches. The Scottish Branch had certain outstanding peculiarities. In the first place it covered a whole country and had the largest territory of any Branch; it consequently had certain difficulties to contend with. Then there was the close co-operation between the Branch and other societies in Glasgow; nowhere else have those efforts been more successful or established on a firmer basis. In these days of specialisation everyone wished to join the society dealing with the subject of their immediate interests, and it was therefore desirable that there should be a close co-operation between them. Another feature of the Branch was the efforts on behalf of the young people. There was the Surtees competition, founded by the late Mr. Mayer, which was doing excellent work in stimulating the interests of the young men. The Branch made a very good attempt in the formation of a Junior Section, it was at the moment in suspense, but he felt certain that it would shortly be renewed.

There was one point in connection with the examinations which he wished to make quite plain and about which there appeared to be some doubt, viz., the admission to the Institute was at present quite open. No doubt some of them had read in the technical Press about the desirability of holding an examination for admission to the Institute. These certificates he had mentioned had nothing whatever to do with that matter, which was one to be dealt with quite separately in the future. He wished them to disabuse their minds that those examinations were to be imposed upon candidates for admission to the Institute.

The Scottish Branch owed its success and enthusiasm to quite a number of members, some of them gone but some of them still with them. There was Mr. Mayer, who gave the Institute's chain of office for the President. Then Mr. Matt. Riddell, who during the war travelled every week to Glasgow to conduct a foundry class. There were others who were actively working at the present time, and he would like to mention one, namely, the secretary, Mr. Bell, and, knowing him as he did, he thought that he would forgive him if he said he knew how much he was respected not only in the Branch but in the Institute. They had a President whom they could follow, respect and admire. The work of the Branch was quite safe in the hands of Mr. Miller. If the work continued unhindered, the Scottish Branch would prosper more than ever before.

A Twenty-First Birthday.

Mr. James Miller (Branch-President), in replying, said that he was very pleased to record the way in which Mr. Makemson had taken notice of the work of the secretary; the work was done without a grudge and with thoroughness. Several things which he had intended saying had already been mentioned. They as a Branch had to do the best they could to assist members in making castings in the very best way. They all knew that the days of generous machining allowances were past; the machine shop now worked with machines of precision and gauges and jigs and was set up to perform the work in the minimum time. The foundry had now to work to very fine limits, so that the castings were practically machined castings before they left the moulding shop. The work of the Institute was to develop and improve methods for the production of perfect castings. They therefore should meet to discuss the problems of everyday work.

The Branch Council had recently had under consideration means for the extension of membership, and very shortly the firms will receive personal letters which will be followed by calls from representatives of the Branch to explain the aims, objects and advantages of the Institute, and it is hoped that the result may be a large influx of new members.

The Scottish Branch will have been in existence 21 years on February 15 next year; that is being taken into consideration. In family life a twenty-first birthday is a great day. Why not in the Institute? In that connection he would like to read a copy of the first minute in the Branch book. "Wednesday, 16th February, 1910. Held in the Foundry Class Room by Professor Campion's (Foundry Class) Students for the purpose of forming a branch for Glasgow and the West of Scotland of the British Foundrymen's Association. The Chairman, Professor Campion, spoke of the great need of such an institution and promised to aid the proposed branch by every means in his power." They were pleased to know that as far as they could see they would have Mr. Campion with them when they celebrated their twenty-first birthday. He thanked them for the manner in which they had received the toast.

A musical programme was given during the evening by Messrs. J. Stoddart, William Storry, J. H. Nicholson, J. C. Dorsie and W. Wallace Andrew.

The Manufacture of "R.R." Alloys.

On page 68 of Vol. 42 of THE FOUNDRY TRADE JOURNAL, Mr. W. C. Devereux, managing director of Messrs. High Duty Alloys, Limited, outlined the properties of a series of alloys known as the "R.R." group. This information is brought up to date by the appearance of two articles in a special pamphlet published by the Bureau of Information on Nickel entitled "Nickel in Light Aluminium Alloys." Mr. Devereux is again responsible for one, and Mr. R. W. Harvey-Bailey, M.B.E., a technical production engineer, for the other. Mr. Bailey, in the course of his article, informs us that during the post-war period a number of new aluminium alloys have been introduced, each with excellent properties for a particular purpose, but the limited range of their application has militated against their general adoption. For this reason much attention has been aroused by the new range of Rolls-Royce alloys, which are being introduced by Messrs. High Duty Alloys, Limited. These are the result of several years' intensive work by Messrs. Hall and Bradbury, carried out in the laboratories and foundries of Messrs. Rolls-Royce, Limited, and are particularly interesting, inasmuch as they traverse the whole range of foundry and engineering requirements.

The range of constituents is as follows: Copper, 0.50 to 5.00 per cent.; nickel, 0.20 to 2.50; magnesium, 0.05 to 5.00; iron, 0.60 to 1.50; titanium, 0.05 to 0.50; silicon, 0.20 to 5.00 per cent., and aluminium, remainder.

Whilst the above specification covers the range in practice, the composition is modified to suit the particular conditions of service demanded. The special purposes for which the several grades are used are:—

R.R. 50.—General sand and die castings.
R.R. 53.—Die-cast pistons.
R.R. 56.—Alloy for forged work.
R.R. 59.—Alloy for use in forged pistons.

The average chemical analyses of the above four grades are given in Table I. The four grades cover practically all the requirements of the general aluminium foundry or forge, but further grading can be carried out to meet very specialised requirements.

One of the important characteristics of these alloys is that they are all amenable to heat-treatment, and their physical properties are considerably improved thereby. In the case of the cast alloys, the conditions of normal casting leave the alloy in such a state that it only requires a low-temperature treatment of from 100 deg. C. to 175 deg. C., ranging over a period of 20 hrs. to 8 hrs., to develop the improved qualities in question. This treatment, incidentally, has been found to result in a noticeable increase in the ease of machining.

TABLE I.—*Composition of the R.R. Group of Alloys.*

	R.R. 50.	R.R. 53.	R.R. 56.	R.R. 59.
Cu ..	1.30	2.25	2.00	2.25
Ni ..	1.30	1.30	1.30	1.30
Mg ..	0.10	1.60	0.80	1.60
Fe ..	1.00	1.40	1.40	1.40
Ti ..	0.18	0.10	0.10	0.10
Si ..	2.20	1.25	0.70	0.50
Al ..	remainder	remainder	remainder	remainder

The specific gravity of R.R. alloys is 2.70 to 2.75; melting point, 635 deg. C., and casting contraction, 1.25 per cent.

Having considered the properties of Y and R.R. alloys, Mr. Devereux deals more generally with the manufacture and application of these alloys.

Owing to the fact that some of the constituents of these alloys have high melting points, it is necessary to adopt special methods in preparation. The first step is to prepare the hardeners, which are rich alloys containing the various addition elements and aluminium. In the case of the R.R. alloys it is necessary to prepare a special hardener containing copper and titanium.

Copper Hardener.

It is usual to make this hardener to include either 50 per cent. or 33 per cent. of copper. The following method is suggested for making the 33 per cent. copper hardener:—67 lbs. of copper should be melted in a Morgan salamander crucible, the metal being covered with a layer of charcoal to prevent oxidation. At the same time 100 lbs. of pure aluminium should be melted in a similar but larger crucible, the melting procedure being so arranged that when the copper is quite fluid the aluminium is also molten and at a temperature of not more than 700 deg. C.

The copper should then be poured slowly into the molten aluminium, stirring the whole time. A slight exothermic action will take place: the increase in temperature due to this and to the copper is kept down by feeding into the crucible, one by one, a further 33 lbs. of warm pure aluminium ingots and stirring the whole time. The temperature must be kept below 700 deg. C. and the above method permits this to be done.

After thoroughly stirring, this aluminium-copper alloy should be cast into ingot moulds. It is a very good plan to use different shaped ingot moulds for each type of hardener in order to avoid any chance of error in mixing when making up the various alloys. Analyses of the copper hardener taken from the first and last ingots to be cast should not vary by more than 0.25 per cent. of copper.

An alternative method of making the copper hardener is to melt 100 lbs. of copper under charcoal as above, and, when it is quite fluid, to add a few ingots from the 100 lbs. of pure aluminium, the metal being left until the thermit action ceases. Then, by further additions of the remaining aluminium ingots, the temperature should be kept below 750 deg. C. When the last ingot has been added, the melt should be thoroughly stirred and cast into specially shaped ingot moulds.

Nickel Hardener (20 per cent. Nickel).

The preparation of this hardener needs very special care. The pure aluminium should first be melted, nickel, in the form of shot, being then added a little at a time. It is necessary to make certain that the nickel is completely dissolved before adding a further quantity, otherwise a pasty mass will form at the bottom of the pot and a high temperature will be required to take it into solution.

The melting point of the 20 per cent. nickel hardener is 780 deg. C. and it is necessary to allow the temperature of the alloy to rise gradually until it finally reaches about 850 to 870 deg. C. The 10 per cent. nickel hardener melts at 680 deg. C., consequently it is possible for lower temperatures to be used in this preparation.

An alternative method of adding nickel is to place the shot in a small "Salamander" crucible, in the sides of which holes have been drilled sloping upwards and outwards. The crucible should be suspended in the molten aluminium at 800 deg. C. and should be moved up and down until the nickel shot is completely dissolved. By this method the nickel can be dissolved very quickly and without any trouble due to the formation of the pasty mass mentioned.

Copper-Nickel Hardener (20 per cent. Copper, 12 per cent. Nickel).

To make this hardener 25 lbs. of nickel shot should be melted in a Morgan salamander crucible: when melting is about to begin, a little hot copper should be added to facilitate complete fusion. Hot copper should be added from time to time, the total quantity of copper being 40 lbs.

When the copper-nickel alloy is thoroughly molten, it should be poured on to 100 lbs. of molten pure aluminium, heated to 700 deg. C., and stirred continually. The temperature must be kept below 700 deg. C. by adding 33 lbs. of warm aluminium ingots, as in the case of the copper hardener. After stirring thoroughly the whole should be poured into special ingot moulds.

It is preferable to keep the nickel content more than one-half that of the copper content, as the more easily made copper hardener can be used to correct the composition.

In the case of the R.R. alloys, the hardeners as described above are used, but it is also necessary to make up a further hardener containing aluminium, copper and titanium. This hardener is made by the "Thermit" process and may contain in some cases 21 per cent. of titanium, 10 per cent. of copper, remainder aluminium, or it may contain only 7 per cent. of titanium.

Sand Castings.

Any of the usual moulding sands, such as Red Mansfield, will be found to be satisfactory and the same applies to the choice of core sands. For R.R. 50 the runners and risers should be somewhat enlarged. Theoretically, in order to obtain a perfect casting, it is essential that the whole of the metal should set at one and the same time. In the case of R.R. 50 alloy, which has been found to possess particularly good casting properties, chills can be dispensed with in the large majority of cases. When it is essential to use chills, it is often advisable to use them in conjunction with a blind riser, if the ordinary type is impracticable.

Permanent-Mould (Die) Castings.

Most pistons are gravity die castings, or at least are cast in a permanent external mould with sand cores. This latter method is often used when the interior of the piston is of somewhat intricate design, since it prevents undue stresses being set up, with the possibility of the subsequent formation of cracks.

Perfectly sound castings are made in gravity dies, but it is essential that the cores should be capable of being released very quickly. The standard practice can be followed with these alloys, but great care must be exercised in keeping the pots and the metal perfectly clean and constantly skimming them out.

Porosity.

Porosity in castings is a bugbear which all aluminium founders from time to time encounter, and methods for overcoming the trouble have been described in a previous article. Providing the original ingot is sound and care is taken in the melting, this trouble can definitely be eliminated.

It is important to reduce to a minimum the time in which the molten aluminium alloys are in contact with the gases and it is strongly recommended that the operations should be done to a time-table. The actual melting should be done quickly, but care must be taken that the heating is not so forced that serious overheating of the metal in the bottom of the pot occurs. As an example it may be stated that a 500-lb. charge of either Y or R.R. alloy should be melted within 1¼ to 1½ hrs. Too often one sees cases of the metal left "stewing" for long periods because the moulds are not ready, or because of some other cause due to lack of organisation.

Porosity and other defects can be distinguished by means of X-rays, which method of examination is in constant use and has given very valuable results.

Hints for Commercial Visitors to the Tangier, Spanish and French Zones of Morocco.—A pamphlet bearing this title has been published by the Department of Overseas Trade. The pamphlet has been prepared by the British Consular Officers at Tangier and Rabat. Reference No. C3,395.

Wages Reduction for Bad Work.

COURT OF APPEAL REVERSES DECISION.

By a Barrister-at-Law.

A Review of Authorities.

In allowing the appeal of the employers, who had deducted 1s. for bad work from the wages of a workman, the Court of Appeal has explored the legal authorities on the subject as far back as the opening years of the 18th century. The judgment just delivered by that Court is undoubtedly more exhaustive on the point than some of the previous judgments have been, although it may possibly be too soon to say that, even now, the matter has been finally laid at rest. The action* originated with the claim of a workman, the plaintiff, to 1s., which the defendant employers had deducted, and it raised an important, but by no means new, question in relation to the wages of weavers, and the right of their employers to make deductions under the Truck Act, 1831, and the Factory and Workshops Act, 1901. It is perhaps unnecessary to discuss at any length the particular Acts mentioned, for their operative effect is fairly well known to persons directly concerned; while the limits of a short article prevent more than a passing reference to those statutes.

No Absolute Prohibition.

By Section 3 of the Truck Act, 1831, it may be observed, however, that the entire amount of the wages earned by, or payable to, any artificer in any of the trades enumerated—which include weaving—in respect of any work done by him is to be actually paid to him in the current coin of the realm. But this section in terms deals with "the entire amount of the wages earned by, or payable to," the artificer, and it does not deal with any system by which these wages are to be estimated, but only with their payment after estimation. Moreover, Section 23 makes an exception of a charge or deduction made at the true value for the supply of materials, tools, or other specified services by the employer, when there is a contract in writing signed by the artificer. It should also be added that a very eminent Lord Justice, in 1892, took the view that certain legal authorities on the point went to establish the fact that a mode of calculating the wages to be paid in which deductions were made might take the case outside the Truck Act altogether. It should be further mentioned, perhaps, that Section 2 of the Truck Act, 1896, provides that an employer is not to make a contract with a workman for any deduction in respect of bad or negligent work unless certain conditions are complied with. But Parliament has not imposed an absolute prohibition on such deductions, and this fact was carefully referred to in the judgment of the Court of Appeal in the present case. By an order made under Section 9 of the last-mentioned Act exemption from its provisions was granted to persons engaged in the weaving of cotton in Lancashire.

The Real Question.

The real question in the case just decided by the Court of Appeal was whether there was a term in the contract which provided that the quality of the work done was to be taken into account in the estimation of the wages payable. The workman sought a declaration in this case that the 1s. which was deducted by his employers from the wages paid to him on account of bad work was due to him, and that such deduction was illegal and contrary to Section 3 of the Truck Act, 1831. The employers justified the deduction on the ground that under the contract of employment the price of the piecework, that was, the wages to be paid to the workman, was for good weaving only; that the practice at the employers' mill, to which the workman assented expressly or implicitly, was to pay for good work producing merchantable cloth only; that that practice, as the workman well knew, included a right to make a deduction from the sum payable to the weaver if the standard was not adhered to by the workman; that the custom of the whole weaving trade in Lancashire recognised that practice, and justified a deduction if merchantable cloth was not produced by the workman; and that the sum deducted was less than the amount of the deduction which might have been made if the employers had exacted the full sum by which the cloth woven fell short of the standard so required.

Relation of Master and Servant.

When the case came up in the Chancery Division the learned Judge there gave judgment for the plaintiff workman on the ground that there was no evidence of any term of the contract of employment which enabled the defendant employers to make a deduction from wages for bad work. In his Lordship's view the alleged usage in the cotton-weaving trade in Lancashire for employers to make deductions from wages for bad work was not one that the law could recognise, because it was precarious, depending on the will of the master for its enforcement; and that, in addition to this, the deduction was from wages, and not a deduction in calculating the amount of the wages, and that it was therefore illegal under the Truck Act, 1831. But the Lords Justices in the Court of Appeal thought it was clear that in such a contract as that under which the plaintiff in this case was employed the defendants would have a right to make a deduction from his wages for bad work unless there was some term of the contract which excluded the right, or unless such a deduction was forbidden by Statute. Although the learned Judge in the Chancery Division had held that that principle was not applicable to the relation between master and servant, the Lords Justices considered that no authority had been advanced for that proposition, and it appeared to them to be contrary to the words in the decisions in certain cases to which they proceeded to refer. In the opinion of their Lordships in the Court of Appeal the relation between master and servant was established by a contract between them which was subject to the rules applicable to other contracts, except in so far as Statute law had superimposed limitations.

A Datum Line.

It had been found as a fact in the Court below that the 3 yards of cloth in question were not merchantable owing to the plaintiff's carelessness, and that the loss resulting exceeded the 1s. deducted; while the plaintiff admitted in evidence that his duty was to see that the cloth was being woven as perfectly as possible. The Lords Justices considered that the learned Judge in the Chancery Division had abundant evidence to justify him in finding that the plaintiff had been guilty of carelessness, and that the plaintiff failed to comply with the proper standard of skill. Moreover, the plaintiff had agreed that the prices in the list, and on the card issued to him, were prices for work carefully done; and there was cogent evidence that the system of deductions in the estimation of the work to be paid for had been long in operation at the defendants' mill. It was difficult to believe that the plaintiff did not become aware that there was such a system in vogue. It seemed clear to their Lordships that the prices in the uniform list provided a datum line above which the weaver might be entitled to be paid if he had been engaged on special work, or had received improper materials to work upon; but it was equally clear that the workman on his part must suffer a deduction if he had not done the good work which the prices were intended to match.

A Disciplinary Purpose.

In allowing the appeal and ordering judgment to be entered in the action for the defendant employers with costs, the Master of the Rolls stated that "it mattered not that those deductions were not always enforced. They might have been used for a disciplinary purpose—to enforce a standard of work by the weavers. They might have thus come to be known among the weavers as fines." Holding that the contract between the parties was of the terms that he had indicated, his Lordship added that it was unnecessary to consider the practice at other mills or in any larger area.

* See FOUNDRY TRADE JOURNAL, August 21, 1930, page 131.

Temporary Preventive for Rust.

The Air Ministry has issued general specification No. D.T.D. 121A (superseding Air Ministry General Specification No. D.T.D. 121), for temporary rust preventive.

With regard to the composition it is specified that the composition of the material shall be lanoline—not less than 50 per cent. by weight (see Appendix I below), dissolved in equal parts of white spirit and solvent naphtha. The component materials shall comply with the following specifications: Lanoline, D.T.D. specification No. 122A; white spirit, B.S. specification No. 245; solvent naphtha, D.T.D. specification No. 123A.

The following properties are required: (*a*) The material shall be a clear solution which shall remain free from sediment or suspended matter when kept at temperatures not lower than 60 deg. Fah.; (*b*) the solution shall give a smooth film of uniform thickness when applied to a smooth metallic surface by dipping; (*c*) when applied at 60 deg. Fah. to a metal surface by dipping, and allowed to dry at the same temperature, the film shall be sufficiently dry in 4 hrs. to be handled; (*d*) the weight of the film determined by the method specified in Appendix II (see below) shall be not less than 0.5 oz. per sq. yd.

Appendix I outlines a method for the determination of concentration, and reads as follows: About 5 grms. of the material shall be placed in a tared flat-bottom dish, about 4 in. dia. by ½ in. deep, which shall then be heated in a boiling-water bath until the more volatile portions have evaporated. The dish shall then be heated for 2 hrs. at 150 deg. C. (302 deg. Fah.), after which it shall be cooled and weighed.

Appendix II indicates a method for the determination of film weight, which is as follows: A tared panel of 30 s.w.g. aluminium, approximately 6 in. by 2 in., shall be dipped into the material at 60 deg. Fah. and shall then be allowed to dry at the same temperature in a vertical position for 8 hrs., then weighed.

The specification is published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2 (price 1d. net).

Efficient Pickling Medium.—In the course of a Paper read recently before the Institution of Welding Engineers, the author, Mr. C. C. Hall, recommended the following solution for removing scale from "18 and 8" chrome-nickel steel:—Water, 50 parts by volume; hydrochloric acid 50 parts, nitric acid 5 parts, restrainer 0.25 part. The bath should be used at a temperature of about 50 to 60 deg. C. About 15 mins.' immersion is required.

Foundry Apprentice Training.

BIRMINGHAM FOUNDRYMEN DISCUSS NATIONAL SCHEME.

In the discussion following Mr. A. E. Berriman's Paper on "Foundry Apprentice Training," which was read before the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, and printed in our last issue, many points of considerable importance in connection with national and local certificates were raised. Mr. A. Harley (President-Elect of the Institute) presided.

A Matter for Employers.

MR. D. WILKINSON (Branch-President), who opened the discussion, observed that the whole question was a thorny one, since the average foundry firm had a considerable dislike to venturing on any scheme that did not produce a monetary return. Yet the fact remained that unless they provided facilities for training their youths, the supply of skilled craftsmen and well-trained technical men could not possibly be maintained. Of course, every firm would prefer thoroughly well-trained men, in comparison with the ordinary haphazard training that most craftsmen obtained; there were few firms which would not choose highly-trained technical men as heads of their various departments, and somehow they hoped to secure them. But it was obvious that firms which desired skilled and highly-qualified men would have to bestir themselves, and this was the crux of the whole matter which Mr. Berriman had put forward so ably.

Two Aspects of Foundry Training.

MR. F. J. COOK said the problem had been before their organisation since its commencement, and it might be news to some that the first object they had was to lift up the status of the foundry. Mr. Buchanan was foremost in promoting the welfare of the boys, and just before the war a strong committee was formed, which drew up a curriculum with a view to issuing it to various technical colleges and schools for comments thereon, so that a suitable scheme could be introduced. Since then their organisation had certainly not been inactive in the matter, and had done more than what might appear to the lecturer. In this connection Mr. Cook referred to the arrangements made for a Mechanical Engineering certificate and a craftsman's certificate. It must be borne in mind that there were two aspects to consider. It was essential to know what they were to aim at: the training of a craftsman, or of a highly-trained technical man. There was room for both, but a separate training was required for each. Therefore the craftsman was supposed to take a course of study for the City and Guilds examination, and the higher technician would undergo a course for the Mechanical Engineering certificate. They had been working on both these problems for a long time, and, as Mr. Berriman had mentioned the one, he might say that both had been launched this year.

An outstanding difficulty was to arrange a proper curriculum for training on the desired lines. For example, they did not require boys to be taught making moulds, because that was what the boys did in the foundry in very much less time. He had been interested in an internal education scheme carried out by an important firm which had proved very successful. No boy from an ordinary school was taken on after 15; but if a boy had passed through a secondary school or through higher education classes he was allowed to come in at 16, and with suitable higher education was taken on at 18 years of age; so the courses of training were for seven, five and three years respectively. Boys were not apprenticed until they were 16, being required to serve a probationary period from 14 to show that they were suitable and willing to benefit by the training given. A programme was mapped out, and they avoided placing any disability on a lad because he happened to be handy at one particular job. It was bad for the training of a lad to keep him to one job simply because he had an aptitude for it. Hence notices were periodically sent to the foremen that such and such a lad would be moved to another department on a certain day, while another lad would take his place, and this was done whether a foreman said he could not spare a lad or not. Of course, the kind of training had to be decided before a boy started his apprenticeship. He was not very favourably inclined to any scheme which provided that a boy should attend one or two half-days a week at a technical school, *unless he proved his worth* and was anxious to take advantage of this opportunity for training, because otherwise he was not doing any good either to himself or his firm.

Incentives for Apprentices.

In the internal scheme there was always something to strive for: every year prizes were offered, determined by attendances and progress made in technical efficiency, until a lad could get two half-days off a week, and sometimes three half-days, for attendance at a technical school. But the boys were not allowed to be taught what they were given to do in the works, the classes being picked out for them and also the type of training. Internal scholarships were provided as well as prizes, and thus a lad could take a six months' course in the drawing office or in the works engineers' office, or some other department. Then, if a youth came up to a certain standard, he went to Birmingham University for a three years' course, and was required to sign an agreement that he would spend the following three years at the works at a scale of pay which was fixed beforehand. During the University vacation the student was allowed a fortnight's holiday, and the rest of the time he spent at the works. The plan proved highly successful, and men who had gone through this training could be met to-day in many parts of the world.

He might point out that the University course did not provide quite the type of men which the firm set out to train; they wanted them to be foremen, but the training produced men fit for higher jobs, and they secured much better posts. He thought they would require a curriculum for the technical schools rather different from that operating in the past, and a special advisory committee would be needed, as the foundry trade was not of the same character as the engineering trade, and further, its members should be keen on the educational side. He did not think they could adopt a hard and fast curriculum for every boy. The boys would have to be studied, and placed in two or three different classes according to their ability and choice of work. There was supposed to be a lower type of boy entering the foundry than the engineering shops, but he could safely say they had improved the situation in this respect.

Apprentices' Age Limits.

Coming to the final points raised by the lecturer, which Mr. Harley desired Mr. Cook to express his opinion upon, Mr. Cook replied in the affirmative to the first six questions as indicated in his remarks, and said it was essential to obtain the correct type of teacher. No branch of the engineering trade wanted boys trained more than did the foundry, nor was there any section in which there was more room at the top, of course for properly-trained men. If a boy was not undergoing a higher education they wanted him before he was 16 (viz., at 14), but not to apprentice him before 16. Boys of matriculation standard they would take up to 18 but not for training as workmen. He would give the lads time off for classes provided they came up to a certain standard. Mr. Berriman interposed that boys of 14 were still children, and they would have to decide whether to allow them time off or not. Mr. Cook replied that a boy would have to show intelligence and willingness to work; then he should be allowed to attend evening classes. He agreed with point 7, and, as to point 8, the University of Birmingham was supplying this need in some substantial measure, although they could not find enough of this type of trained men. He was satisfied that the University was giving these young men the type of training suitable for foundry work from the national point of view, and there were bigger openings now than ever for them. He also agreed with point 9 as to the completion of a course of study and the award of a certificate of practical apprenticeship if a committee of practical men were satisfied with the student's work.

Certificates of Practical Apprenticeship.

MR. HARLEY inquired would the Coventry scheme fit in with that of the Institute, to which MR. COOK replied that he saw nothing against the plan subject to aiming as well at the higher technical certificate. MR. BERRIMAN observed that the new element in the Coventry scheme supposed that there already existed a national certificate, but their attitude was that this national certificate was unobtainable by many boys, who were nevertheless very good boys at their work. The only other award for them was the annual certificate of the technical school or college, which was very nice and desirable. Therefore what they had agreed to in Coventry was that those who qualified by passing the primary stage should be given a certificate of practical apprenticeship on its completion on the judgment of the committee of practical men in conjunction with the college. It would show that the lads had been trained. MR. COOK said that this fitted in with the Institute idea, because they had in mind two types of boys: one who would attend the higher technical classes and go on to a technical college or the University, and the other whose training was to make him an efficient craftsman, which they had more particularly in view. This dual problem was their difficulty for a long time, but they had now provided for these two types by the City and Guilds examination for craftsmen and the Mechanical Engineering certificate for the more highly-technically trained man.

Wider Experience Desirable.

MR. H. HARRISON, alluding to the production of craftsmen, asked how far did they propose to train the lads, whom he said were generally put on unskilled jobs first of all and then progressed to semi-skilled work. Instancing motor cylinders, he asked how many years would it take a lad, and how much training was to be given him, to produce a good job of this character. The lad must learn how to ram up and core up, and how to make a complete set of cores, yet he ventured to say that very few foundries permitted their lads to do such work. His view was that a lad should go right through the foundry and be given the chance to do various jobs. A lad whose experience had been confined to light castings would be lost if it came to work on a 40-ton condenser. He did not know of a Coventry firm, except perhaps one, where loam mould castings were made; and circumstances such as these would render it difficult to produce a thorough craftsman without a prolonged period of training of a wide character. Moreover, they might secure in a jobbing moulder one of their finest skilled men, but when they considered that a workman could not command much of a wage, they must realise the difficulty of getting lads to undergo train-

ing, especially as the semi-skilled man could often make double time. Therefore, unless they made the work attractive from a wage point of view, they would not, he was afraid, be very successful in finding more entrants into the foundry. He had seen hundreds enter the foundry trade, some of them with a real aptitude for the work, but they afterwards found more lucrative jobs.

He thought that the Middlesbrough scheme was a step in the right direction, and his own view was that it was scarcely possible to produce a really good craftsman whose work on training was confined to a single foundry. How many lads were allowed to go through the higher regions of the trade: taken out of the iron shop into the aluminium shop, and so on, and given a careful training? There were very few, with the result that they had a dearth of skilled men, and there would be a greater dearth in ten years' time unless the present system was altered. They were only producing semi-skilled men by preventing a lad going through the various shops in which he would gain wider knowledge and practical experience.

Mr. Berriman felt that the last speaker had touched the root of the problem, and said in support that if there was a single foundry manager who had the power to solve it for himself he needed the support of his colleagues and the foremen. The Coventry scheme was based upon that support for any rational scheme which the foundry people wished to carry through. The Employers' Federation, which was pretty well the only Association in the engineering industry which was regularly attended by responsible men, was earnestly desirous of giving foundry managers every chance of putting into practice any such scheme decided upon, and he did not know how they were going to carry it out unless there was some organisation of the kind to sponsor it.

Obstacles to Craft Certificate.

Mr. Harley, remarking that he was interested in the initiation of the Institute scheme, said that, so far as the national certificate was concerned, the position seemed logical and clear: a Mechanical Engineering certificate standard had to be attained as applied to the foundry. But when it came to a craft certificate he felt obliged to wait for its development. He believed there was an influential committee preparing a syllabus on which craftsmen were to be trained. But how was any syllabus prepared by the cleverest men in the country going to cover the whole of the foundry trade in its various aspects and districts? Mr. Harrison had mentioned the vast difference between Coventry and Rugby: how would a syllabus operate in the training of craftsmen in those two places? At present his own view was that a craftsman's certificate of a general character would not work satisfactorily, but that the Coventry scheme would work well so far as their district was concerned. They had adopted the principle that in training craftsmen, and various grades of craftsmen, they must work from the local viewpoint. The Coventry certificate would immediately inform an employer what a particular boy was good for, the character of the work he had been engaged on, what he had done in the technical college, and also that he had been of good behaviour and possessed character. He was afraid that he could not fit in the Coventry scheme with the Institute scheme as to a craftsman's certificate. If both schemes went forward, a local boy would take the Coventry certificate, and also try and get the City and Guilds certificate. If he was a very smart boy, he would go on studying to secure the national certificate, and the first two certificates would clash. He suggested that the Coventry scheme was far better than the national scheme now being promoted for craftsmen's training, as it was impossible to arrange a national examination in view of the widely different classes of work done in different districts.

Mr. Cook replied that the instruction at technical schools was not so much to teach and do the actual work of moulding and so forth, but rather to impart the technical knowledge required by the craftsman in performing his work, which would naturally be of advantage to him. Thus technical instruction on sands and similar training would be given, but it would be in less degree than for the higher certificate.

Mr. Berriman inquired would the City and Guilds be willing to issue their certificate on the findings of the local trade science course examination of the type they had in mind.

Mr. Cook pointed out that the City and Guilds was not a craftsman's certificate in the first instance, but represented the type of technical education which the craftsman required. It was a technical certificate for craftsman, he said in further explanation.

Assessing College Examination Papers.

Mr. D. R. MacLachlan (Principal of the Coventry Technical College) said they were against external examinations as not being suitable, and the national certificate did not get over this difficulty. The scheme they favoured was for examination papers for the third year to be set by the teachers themselves, but these were sent up to an assessor for him to assess and approve, such assessor being appointed by the Institution of Mechanical Engineers or the Institution of Electrical Engineers, and the teachers to do the examining themselves. That allowed the Technical College liberty to alter the curriculum to suit the needs of a particular industry. However, he should think there would be no difficulty in their curriculum going through by arrangement with the City and Guilds for the final examination, but internal examinations were much to be preferred to external ones. He was afraid the average boy of to-day did not want to enter the foundry, although there were splendid opportunities, but the fact was the foundry had a bad name for some reason or other, and dirty work was not in its favour. He thought the question of remuneration had something to do with it.

Mr. G. S. Roberts, as one of the Employers' Committee, said their desire was not only to give their lads a practical training in the foundry, but by attendance at the technical college to enable them to acquire a very fair knowledge of the theory of foundry work.

Mr. Berriman added to this that if they were successful in getting apprentices the employers were prepared to offer prizes to those who did creditably and encourage them in other ways.

National Scheme Essential.

Mr. T. G. Bamford (Wednesbury Technical College) thought they could not raise the status of the foundry without a national scheme, and the City and Guilds did give such a status. The Coventry scheme was an advantage locally, but it did not give that status which a national scheme would. He did not think it was wages which kept boys away, as many of the boys in the foundry trade attending his college were paid better than boys in the engineering and metallurgical sections, and there were more boys in those sections. He thought it was more a matter of status which weighed with the lads and their parents. If Midland firms would copy the Middlesbrough scheme of taking their young fellows round different foundries, it would be an advantage. Coventry was, of course, comparatively homogeneous in its industries in contrast to the scattered areas in the rest of the Midlands. Did those present consider that a foundry was a necessary or desirable part of college facilities, and did they think it would be possible adequately to teach trade science without a foundry? If a foundry was desirable, what did they regard as the necessary type of equipment? Should a foundry have a cupola, for example? Personally, he thought some equipment of this kind was necessary to enable the students to understand and grasp foundry science, and to this end there ought to be opportunities for them to do a certain amount of practical work.

Mr. Cook said he liked the idea of boys going into different shops, but pointed out that there might be competition for posts as a result.

Mr. Berriman considered there would be no trouble on this score if they secured enough apprentices.

Mr. Harley observed on this point that the modern trend in foundry production was towards the elimination of what they called the skilled moulder. At the same time there were great opportunities for clever boys who studied the technique of production: sand problems, metallurgical problems and scientific problems relating to shrinkage. But they were not going to employ in modern foundries hundreds of skilled craftsmen, because they did not need them. They must differentiate what they required a boy for. The labour in foundries would be done by fairly strong men who did not need to have a high degree of skill; the other class would have work to do requiring intelligence and knowledge, but this class would not be set to make moulds.

Co-operation of Employers.

Mr. Berriman remarked that if there existed a town certificate for Birmingham, Manchester, Newcastle, and so on for engineering apprenticeship, it would begin to take on a national aspect, and this plan was the way to develop and grow from the roots, as it were. At present he was awaiting the views of the Principal of the Central College at Birmingham on the matter. But the scheme would never succeed unless it was founded on the firms themselves. The Middlesbrough scheme was an attempt to found it on the college. Regarding a foundry as part of a college equipment, trade science was something quite definite and did not mean trade technique. This should be taught in the shops. Whether the colleges taught it was their own affair. He thought the scheme would tone up the lads by friendly rivalry, and the certificate would encourage them to some ambition. If the boys were going to get a square deal from their firms, he did not think it of much use the colleges going to great expense to equip themselves.

The Coventry scheme filled their requirements better than the national craft scheme, although in this connection he bore in mind what Mr. Cook had explained as to the intention of the City and Guilds examination. However, the Coventry certificate could be endorsed, and whatever other certificates were gained could thus be boldly shown on this certificate.

Answering Mr. Bamford, Mr. Cook said he thought it was possible for the City and Guilds and the College final examination to be the subject of a joint arrangement.

The President (Mr. Wilkinson) suggested that they had lost sight of the intelligence and enthusiasm of the boys. He did not think it was any use putting a foundry in a college, as commercial work was not taught there, and his experience of castings at an instructional foundry was not encouraging.

The Coventry Scheme.

Finally Mr. Cook said he thought the Coventry scheme was a very good one, and should go a long way towards securing what Coventry wanted. Mr. F. C. Pearce also said the scheme appeared to be a good one, although a seven years' period was rather long. It would be still more advantageous if boys were moved about from shop to shop, and also from one foundry to another.

The lecturer was heartily thanked for his services in airing the problem so ably, and in acknowledgment Mr. Berriman said that the scheme was supported by eight large firms, and whatever those firms agreed upon was most likely to succeed.

XUM

Utilisation of Nottinghamshire Sands.

SCIENTIFIC CONTROL AND TESTING DISCUSSED.

Following the presentation of MR. FRANK HUDSON'S Paper on "The Characteristics and Utilisation of Nottinghamshire Sands" to the East Midlands Branch of the Institute of British Foundrymen, a discussion ensued which embraced such matters as the fritting and washing of sand, mould-hardness tests, ramming and the use of oil-sand cores.

"Fritting" Defined.

MR. J. C. HALLAMORE said he wanted to find out whether there was any particular standard that one could work to. He used red Mansfield sand, and very often it contained a large number of yellow lumps. Was that good or bad? Mr. Hudson had also used the word "fritting," and he was not clear as to its true import.

MR. HUDSON said that fritting was a term applied to sand or fractures where partial melting had taken place. In regard to gases, he quite agreed that when a moulder saw a quantity of gas coming out of the vents, he thought the vents were working well. It would be much better if he did not require to vent it. With regard to hardness, he could not give any definite mould-hardness figures for the jobs about which Mr. Hallamore asked. Hardness tests, however, had been conducted on different methods on ramming moulds; where hand-ramming had taken place, power-ramming, and also on jobs where the sand slinger had been used. These figures were available and would be sent to Mr. Hallamore. With regard to yellow lumps in Mansfield red sand, they need cause no worry. Perhaps in the yellow sand there was a little more clay.

Theory of Sand Washing.

MR. J. LUCAS (Loughborough) raised the question with regard to sand being washed, to which Mr. Hudson had referred, and asked if it were better that the sand should be washed before it was used. Having seen all the statistics which had been quoted, he wondered whether Mr. Hudson really advanced the idea that washed sand was going to be part of the sand preparation in the foundry.

MR. HUDSON said he did not for one moment infer that sand should be washed in a foundry. He had put the sand-washing theory forward where the idea was required for the fineness of the sand or where an idea was required of the sizes of the sand grain comprising the sand. It was purely a laboratory test for washing the sand, but at the same time it would show some valuable and interesting points. He agreed that to think of hand-washing sand would be a foolish proposition. It sometimes was advisable to pay for a washed sand, especially when high-class and delicate jobs were being undertaken. This course had proved very valuable.

Sand Refractoriness.

MR. W. PYATT (Leicester) said he took it that fritting was partial melting of the sand. The different sands had a different percentage of iron oxide, therefore he would like to know if iron oxide had anything to do with fritting, or what effect it had on sand.

MR. HUDSON said that iron oxide existed in such sands as Mansfield, but it was a totally different iron oxide from what they might think. It was not like the ordinary iron oxide. It all depended on the kind of sands. The amount of natural iron oxide would determine the relative feasibility of fritting, and they could assume the more iron, the more fritting. The quantity required was relatively high, somewhere in the neighbourhood of 20 per cent. It was a point very little known about to-day, because some of the red sands containing iron oxide had been found to be more refractory than those which did not contain iron oxide. Why that should be so, he did not think anyone to-day could really say. The whole question of refractoriness was practically in its infancy.

Mould Hardness.

MR. E. STEVENSON (Nottingham) asked why it was that clay-bond sand required more oil. In ordinary sea sand he used 40 per cent. of sand to one of oil. He would like to know what actually took place. Was it chemical action absorbing the oil, or was it the clay that absorbed it? With regard to the hardness tests, he thought it was a pity they could not get some idea of the various hardnesses required for the different moulds; in fact, it was a pity someone had not spent some of their time in their lives to determine this. The concrete mixers had a standard of hardness for their different work, and yet the foundryman's chief tool was a sand mould, and they had no proper data. It was about time they had.

MR. HUDSON said that clay-bond sand required more oil, due to the fact that clay acted as an absorber. It soaked water and also soaked up the oil. Two per cent. by weight of oil was a very economical proportion. The function that oil had to perform to obtain the maximum strength was to get each silica grain covered with a uniform filament of oil. There was just enough to coat the silica grains. If, by any chance, some of the oil was absorbed by the clay there was less oil to coat the silica grains, and that was the reason why the strength was less. With regard to the hardness testing of the moulds, he personally had done all types of ramming in sand, and the hardness varied from 16 lbs. to 28 lbs.

MR. STEVENSON asked why it was that clay in sea sand took 50 per cent. more oil to bring it up to strength.

MR. HUDSON said it depended on where the sea sand was reclaimed. If they reclaimed sea sand and made it uniform in grain it would be satisfactory. Reclaimed sand was equal to new sand. They could take, for instance, the case of the textile foundries, where coal dust is used generously. It was surprising, for no matter how much water was added to the sand it was always dry. The coal dust seemed to absorb part of the water, and it certainly kept the sand dry. Another reason why sand was dry was because it was made so very fine to give a beautiful finish to the job. The same applied to the core sand. If the sand were dry they would get the same thing happening as if clay were present. They could take sea sand and divide it into coarse and fine, and they would find that the coarse sand made the stronger cores.

Expansion of Green-Sand Cores.

MR. B. H. VAUGHAN raised the question with regard to the expansion of a green-sand core, and instanced as an example a frame. If a bar were pressed through the centre to form two cores, would the core increase in size or did it expand in cooling off?

MR. HUDSON said two things happened. In the first place there would be a definite expansion, but by the time the casting cooled down in all probability the expansion had disappeared. He had found it so in his tests. He measured up the cores, but he removed them from the oven first. There was always a definite expansion, but immediately the core was cooling down, the whole began to crack in small pieces. He thought they would get a definite expansion of the core after the job was cast. In green-sand work they need not worry, as there was enough strength.

MR. STEVENSON: Would it crack in a sea-sand core?

MR. HUDSON: No, the oil is so pliable that it is allowed to give.

Grain Size.

MR. P. A. RUSSELL (Leicester), speaking with regard to the grain size of sand, asked if the microscope were of any real value in determining the size. It seemed a simple way, but too simple to be true.

MR. HUDSON said it was rather remarkable how even a man could ram. Due to one man ramming all the time he had never yet had a scab core. If making an ordinary core and coarse sand were used it did not matter about ramming, because in such circumstances ramming had no benefits. With regard to sand tests, he admitted that a photographic test was satisfactory, but was expensive, and he thought the sieve test was the cheaper method and gave the necessary results. Replying to Mr. Vaughan, he said his remarks on cracking of castings had reference to the use of sea sand. If an oil-sand core caused a fracture of an iron casting, he would immediately say that too much oil was being used. They could cause cracking by making it very hard through so much oil being present. In aluminium practice it was very important. He thought most of the cracks in aluminium were due to hard cores.

MR. VAUGHAN said he meant white iron.

MR. HUDSON admitted that one could crack castings by using sea sands.

Amount of Oil Required.

A Member asked what would be considered the minimum percentage in oil-sand cores.

MR. HUDSON said they could make certainly satisfactory cores by using 1½ per cent. by weight of oil. Disintegration was fairly rapid, but, of course, they must take into account the thickness. Another fact which they did sometimes find, was that trouble due to oil-sand cores was in consequence of the foundryman only half making the cores.

MR. T. A. SPIERS (Leicester) said, when they came to machine-made moulds, they could do with them twice as hard as hand-rammed moulds.

MR. HUDSON said the object of testing sands was to make the job better. The cheapest sands were, perhaps, the poorest every time. Proceeding to refer to a good system of checking defective castings, he mentioned his own personal experience. They started on one job at a time to trace the defect. They began with the sand, and the result was that the faulty castings were lowered to 3 per cent., and they kept them at that.

Vote of Thanks.

MR. C. W. BIGG (Derby), in proposing a vote of thanks to Mr. Hudson, said it had been most entertaining and instructive. He did not, however, come to the most important point until the finish—the human element. He did not think they knew enough about ramming. Mr. Hudson had put facts in front of them.

MR. LEECH, in seconding the vote of thanks, said they would have good cause to remember the Paper by what they had learned. He hoped Mr. Hudson might address them again at some other time, and outline some ways of utilising the ideas put forward, whereby they might get sand control into the foundries. Personally, it seemed to be a very difficult job and one that would involve a great deal of expense.

After MR. HUDSON had replied, a vote of thanks was accorded Prof. Bulleid for the facilities placed at their disposal at the University College, the Professor being asked to convey the expression to the proper authorities.

An excellent lubricant for raw-hide gears can be made from a mixture of tallow and graphite. On no account should mineral oils or grease be used.

New Blast Furnace at Anshan Works, South Manchuria.

The following particulars about the new 500-ton blast furnace are extracted from the "Far Eastern Review."

The completion of the new 500-ton blast furnace of the Anshan Steel Works raises the pig-iron production of the plant to 1,100 tons per day. The old blast-furnace plant at Anshan consisted of two 300-ton furnaces, producing 200,000 tons of pig-iron per annum. The erection of the new 500-ton furnace became imperative to permit the old furnaces to undergo necessary repairs; but it is really intended as a reserve unit in order to assure a constant minimum annual output of 200,000 tons.

The new furnace was designed by Mr. Kohlhaas, Consulting Engineer, of Perrin, Marshall & Company, of New York, but its actual construction was carried out by various Japanese manufacturers; the steel castings being supplied by the Sumitomo Steel Works, the plate work by the Kawasaki Dockyard and other parts by the Dairen Engineering Works. The contract for the hoisting machinery and equipment went to the Otis Elevator Company, of New York; the coke-screening machine to the Robbins Conveyor Company; the furnace bell and hopper to the McKee Company; and the firebricks for lining the furnace to the General Refractory Company of America. The actual erection of the furnace was carried out by the Anshan engineers.

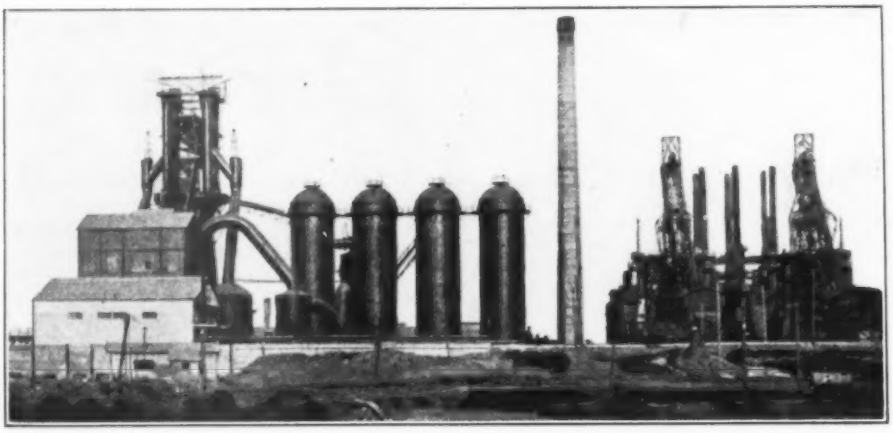

Fig. 1.—View of Blast-Furnace Plant at Anshan Works, South Manchuria.

The new furnace is 27.43 m. high, with a hearth diameter of 5.64 m. and an inner volume of 693 cub. m. The following data were used as the basis for its design:—

Analysis of iron: Si, 1.50 to 1.80 per cent.; C, over 3.50 per cent.; Mn, over 1.20 per cent.; S, under 0.04 per cent.; P, under 0.35 per cent.; Fe, about 94.00 per cent. The furnace is to operate a sinter burden with only a small amount of iron scrap. The basic figures for the furnace are as follow:—Sinter, 1.750 tons; scrap, 0.025 ton; coke, 1.000 ton; limestone, 0.800 ton; slag quantity, 0.900 ton.

The new furnace was blown in on March 9 last, and has since been producing from 500 to 550 tons of pig-iron per day.

Mr. G. H. Harrison, "Hazelmere," Knoll Avenue, Swansea, has been appointed agent for the Power Plant Company, Limited, West Drayton, in the South Wales district.

Work is proceeding on the excavations for the new hotel which will occupy a site of 56,000 sq. ft. at Marble Arch, London. The steel frame is being manufactured and erected by Messrs. Dorman, Long & Company, Limited, and will weigh over 10,000 tons. Deliveries are expected to commence early in January.

Determining the Hardness of Chilled Castings.*

As is well known, hard cast iron poured into chilled moulds possesses a skin of hard white iron which changes little by little with depth to softer grey iron. Being given the applications of chilled cast iron, it is very important to be able to determine the relative hardness with accuracy. The Brinell tester gives very acceptable results; the variations obtained between two tests, one carried out in the works and one in the laboratory, on the identical finished casting, have been from 0 to 10 Brinell units in 27 out of 35 cases, and from 11 to 18 units in the remaining 8 cases. These variations, due mainly to measuring errors, should be considered as of little importance; but usually the tests have to be conducted on large finished castings. The impression of the ball, for example, on polished rolls is not admissible, because one can only make it disappear by redressing the casting, which involves considerable expense for so hard a metal, and has especially the serious drawback of reducing the thickness of the extremely valuable hard skin. The variations become very much greater when the Brinell hardness exceeds 600, as is the case of certain special irons.

The scleroscope method does not injure the casting, as the impression produced by the fall of the diamond point is quite insignificant, but it presents certain drawbacks. The variations between two individual tests can reach 14 scleroscopic degrees, but the variations of the averages of 50 tests scarcely at all exceed $\pm$ 1 per cent. As the tests are made very rapidly, the very high dispersion of individual tests does not prevent the method being applied. The apparatus used often deteriorates, but with careful examination and readjustment one may easily remedy this inconvenience. The results can differ from 1 to 3 degrees, dependent upon the manner in which one operates; for example, when one is dealing with large castings, on which the apparatus is posed, as is most frequently the case for iron castings, the values obtained are generally lower than when small castings are tested in a fixed scleroscope.

There is, however, a much more serious drawback to the scleroscopic method; if two different pieces of apparatus are used to determine the hardness of a standardised hardened-steel test-piece conformable values are obtained; but if, in the same way, the hardness of iron castings is measured, startling variations of about 10 degrees are found. Attempts have been made to explain these variations by constructional differences in the pieces of apparatus, by the shape of the diamond points, and in the manner of making measurements, but searching tests have shown that it is not so. These variations are so important that the method is rendered inapplicable in practice unless one can find a means of obtaining conformable values with different pieces of apparatus.

To this effect the author suggests the following procedure: Determine the scleroscopic hardness S_1 of a hardened-iron test-piece of which the Brinell hardness B_1 is known. Determine with the same piece of apparatus and under identical conditions, the hardness S_2 of the casting to be tested. The Brinell hardness B_x of this casting can be calculated by the expression

$$B_x = B_1 + (S_2 - S_1)\frac{B_1}{S_1}.$$

According to whether the hardness of the casting is greater or less than that of the standardised test-piece, the value of the factor $(S_2 - S_1)$ will be positive or negative. In the limit case when $S_1 = S_2$, equally $B_x = B_1$.

In the zone of hardnesses to be considered for hard cast iron, the factor $\frac{B_1}{S_1}$ is equal to 6 or 7. Suppose, for example, that $B_1 = 518$, $S_1 = 84.9$ and $S_2 = 85.5$, then B_x will be found to equal 522. The Brinell hardness test has given the result, $B_x = 517$.

This calculation allows one to obtain, within the zone of hardnesses for hard cast iron, results practically independent of the piece of apparatus used, inasmuch as one only measures directly the difference in hardness between the standardised test-piece and the casting to be tested. One therefore profits by the considerable advantage of the scleroscope in that it does not deteriorate the casting by an impression, as, for example, would be the case with finished rolls. If there are available a number of hard iron samples having their Brinell hardness numbers scaled out to about 20 units over the whole hardness range of this type of metal, one can then trace curves giving, for each apparatus, the relationship between the Brinell units and the scleroscope degrees, thus allowing of the immediate reading and without any calculation of the Brinell hardness from the scleroscope.

* Extracted from "Kruppsche Monatshefte," X, pages 200-203.

Iron and Steel Output in November.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast declined by 4 during November to 92. Production of pig-iron in that month amounted to 384,100 tons, compared with 415,000 tons last October and 631,400 tons in November, 1929. The production included 107,500 tons of hematite, 143,600 tons of basic, 102,500 tons of foundry, and 18,000 tons of forge iron. The November output of steel ingots and castings amounted to 433,700 tons, compared with 512,500 tons last October and 815,000 tons in November, 1929.

In his address at a meeting of the Institute of Industrial Administration, on Friday, December 12, Mr. A. S. Comyns Carr (President) said that, although industrial administration was a necessity in every industrial enterprise, there had been in the past in this country few accepted canons regarding its practice; and each firm had tended to evolve its own methods exclusively by process of trial and error, with varying degrees of success and of adaptability to conditions. Progress had been by slow process of tradition. There had been little conscious application of scientific principles to management in the way that technology so forcibly demonstrated. The Institute claimed to have succeeded in combining in one comprehensive view the principles underlying the various aspects of industrial administration. It aimed at establishing industrial administration among the recognised professions; at the education of the younger members; and at the maintenance of a high standard of skill and responsibility among those already qualified or who might become qualified.

Belgian Sand.

At a meeting of the West Yorkshire Branch of the Institute of British Foundrymen, Mr. H. Sayers presiding, MR. F. GRIFFITHS repeated his lecture on "Some Aspects of Modern Foundry Practice."* An exceedingly practical discussion followed, the main points of which are abstracted below.

The BRANCH-PRESIDENT (Mr. Sayers) said they had listened to a very clear exposition, by a practical man, of the use of a particular type of sand. It was perhaps rather unfortunate that the use of this obviously desirable sand necessitated refined methods of clearing-up the sand after use—methods which, to his mind, were perhaps hardly practicable in every jobbing foundry under present conditions. At the same time, as one concerned with much jobbing work, he was tempted to try these methods and this sand.

English Sand Replaces Belgian.

MR. W. G. THORNTON said that from his own experience he could endorse a great deal of what Mr. Griffiths had said in regard to Belgian sand, but he was rather surprised and a little disappointed when Mr. Griffiths said he had not been able to find an English sand which would do as well, because he (Mr. Thornton) was satisfied that he had found such a sand. Evidently Mr. Griffiths' methods and his (the speaker's) must be different. Mr. Thornton said Belgian sand came to his notice just after the war, and he went to Belgium and got into touch with Mr. Fosseprez, and as a result he returned to England and installed Belgian sand himself. It revolutionised the casting work, but the difficulty was, they had to have the place absolutely clean before they started work and they always had to move the sand away from any other sand if they wished to get the correct and proper result. That, of course, in itself involved a radical change in foundry methods and a certain amount of labour. If that strict cleanliness could be assured he was quite in agreement with the lecturer that in the long run Belgian sand would prove cheaper than English, but in how many English foundries was that strict cleanliness likely to be maintained?

Should Coal Dust be Used?

Mr. Griffiths had mentioned getting a satisfactory mixing when using as low as 7 per cent. of new Belgian sand, but the speaker had actually worked as low as 3½ per cent. new sand and the remainder old, with quite good results. With this mixture the mould, when made, was like a stone, and there was no scabbing. He was rather surprised to hear Mr. Griffiths speak of the use of coal dust; so far as he (Mr. Thornton) could recollect, Mr. Fosseprez was definitely against that. In Mr. Thornton's use of Belgian sand, coal dust was never used. For their big jobbing work they found the Belgian sand not very successful, but this was probably due to insufficient ramming. The men had been accustomed to ramming as required for ordinary English sands, and it was extremely difficult to get them into the way of the very hard ramming needed for Belgian sand. In fact he was afraid, in the particular foundry where this sand was in use under Mr. Thornton's control, they never did really get the men into the way of sufficiently hard ramming. Also, if one was using bad patterns—such as the average jobbing foundry often had—this was a very difficult sand to mend and patch because it would not take water. Mr. Griffiths said he was speaking of a modern foundry, and he suggested that his methods were equally applicable in any other modern foundry, but in practice Mr. Griffiths was speaking from his own point of view only, because whilst they were all trying to attain the best results with the most modern methods, in every foundry one visited one found the methods somewhat different, so he (Mr. Thornton) hardly thought anybody could speak of the perfect modern foundry as yet. In regard to the cupola block, he had seen that in Belgium and used it in his own place for several years. It was a very good idea, but he suggested that when one was using the two-hole tap it was impossible to get slag into the ladle because the metal from the bottom of the cupola had to go right from the bottom to the top, and this was one of the important points in that system.

Facing Sand Standardised.

MR. GRIFFITHS, in reply, said he must congratulate Mr. Thornton on having got a good mixing with only 3½ per cent. of new Belgian sand. He himself considered he had practically got to the limit when he got down as low as 7 per cent. In his own case they used the same facing sand for what they called the jobbing work. Some 20 or 30 per cent. of the work at his place was jobbing work. Perhaps this was why they had not attempted to go below 7 per cent. new sand in the mixing. He was rather surprised to hear Mr. Thornton say Mr. Fosseprez did not recommend the use of coal dust, because he (Mr. Griffiths) had first seen it in use at a works where Mr. Fosseprez served as foundry manager. To his mind the coal dust was a distinctly valuable factor. On occasions when the available supply of coal dust had been rather low and the man had had to put in less than the usually stipulated quantity, the shortage had been easily discernible. For getting the smoothest surface of all he could recommend that second sand, the brown sand, of which he had spoken. In regard to Mr. Thornton's question as to the slag, Mr. Griffiths reminded the meeting that he pointed out in his talk that they got no slag whatever in the ladle.

Flow of Sand.

MR. L. FARRAR, speaking of the 4-ft. 6-in. square boxes with 12-in. top part, asked whether the ramming of sand was by hand or by machine and how much sand should be put in for an ordinary ram by hand?

MR. GRIFFITHS: About six inches, then rammed and afterwards more sand added.

MR. S. W. WISE said he believed the idea behind Mr. Farrar's question really was as to the flow of the sand, the Belgian sand being a rather stiff sand.

MR. GRIFFITHS said it was true there was not quite the same ready flow as with English sand, but in his experience they had found no difficulty in regard to the flow. On a plant with a pipe-line they found that, where English sand tended to clog at the joints, this was not the case with the Belgian sand.

MR. W. PARKER said he understood with Belgian sand it was possible to ram close to the pattern—within an inch or so—without any fear of scabs. Was it a matter of ramming so that there were no joints between the rams?

MR. GRIFFITHS: Yes.

Dampness Necessary.

MR. THORNTON said it would be interesting if Mr. Griffiths would mention the consistency of the sand as to dampness; whether it was used wet or dry.

MR. GRIFFITHS then described the method of making facing sand. Two men shovelled into a loader 14 cwts. of backing sand to which was added 1 cwt. of new sand and 30 lbs. of coal dust—2 lbs. of coal dust per cwt. of facing sand. That was elevated in the mill. Water was added by a man who by experience could tell when the mixture was sufficiently wet. In the wetting it changed from brown to a darker colour, and when the man realised it was wet enough he shut off the water and knocked a lever which allowed the mixture to be dropped into a receptacle. If the sand should, by mischance, get into use a little too wet and rammed just the same, the gases would get away, without any scabbing. There was not the same difficulty in regard to dampness that one experienced with English sand.

MR. THORNTON: But you have crude oil.

MR. GRIFFITHS: Yes, we do use oil with the facing sand when half the quantity of coal dust is used, but no oil is added to backing sands.

In answer to Mr. J. J. Watson, the LECTURER agreed that if the sand was much too wet the casting would be rougher. If it was excessively wet it would be sent back to the man responsible.

MR. PARKER asked when Mr. Griffiths faced the pattern with the facing sand and put in the backing sand, did he get the amount of density he required without any hand ramming?

MR. GRIFFITHS: I think in all jolting machines you must flat ram the superabundant sand on the surface of the box.

MR. THORNTON said he had been particularly impressed, whilst in Belgium, with the dryness and the consistency of the sand. When he got home he found the consistency of the sand was too wet. Eventually they got it right. He was required to use the Belgian sand dry, and he still felt that the oil content had something to do with the matter.

MR. GRIFFITHS said he was quite convinced in his own mind that the oil had nothing at all to do with the consistency of the sand.

In answer to a member's question as to what was the position with Belgian sand in regard to mending up a mould if there were parts dropped, Mr. Griffiths said one could follow the ordinary methods one would use with English sand, but the Belgian sand was more likely to remain in the mended place than an ordinary English sand.

Crude Oil Used Successfully.

MR. WISE said he wished to congratulate Mr. Griffiths on having given the West Riding Branch one of the clearest and most explicit talks they had ever had. It was not given as if to elementary students, but was given in such a simple way that all present could appreciate its points. Mr. Griffiths had had more courage than a good many when the Belgian sand was introduced into this country about 1922. Quite a number took it up at the time, but dropped it without going into it thoroughly. Mr. Griffiths had gone into the question persistently, and the quality of his castings showed that he had brought its use to a successful issue. A good many of them had questioned in their own minds as to the matter of scabbing with so close a sand, and had had doubts as to whether the Belgian sand flowed so easily as ordinary English sand, but Mr. Griffiths had cleared up those points rather convincingly. One would be interested to know if Mr. Griffiths, when using the crude oil in the sand, had any difficulty in moistening it down in the mixing—was there difficulty in getting the water mixed in the sand? He (Mr. Wise) asked this question because he had heard some people who used crude oil declare—and he had experienced it himself with linseed oil—that there was difficulty in mixing afterwards. He would also like to ask if Mr. Griffiths had had any substantial trouble from porosity. There was a growing opinion in the foundry world, said Mr. Wise, that porosity was caused, possibly, through the trapped gases rather than being purely a metallurgical trouble.

MR. GRIFFITHS said there was no oil actually put into the backing sand. The backing sand was such as had become ordinary floor sand, went to the mill, was put into the bucket elevator and the water was added, and when it was the correct colour the water was stopped. There was no trace of oil in it. So far as concerned mixing water in the sand which had crude oil in it, he had experienced no difficulty. In regard to porosity, he had, like everybody else, far too many porous castings, but he thought it was not caused by the sand so much as by the cheap mixing of iron that they were all out for. He had not yet had occasion to attribute porosity

* See FOUNDRY TRADE JOURNAL, December 5, 1929, pp. 400 *et seq.*

to Belgian sand, and he agreed with Mr. Wise's suggestion that quite a lot of porosity was due to trapped gases.

In answer to a question by Mr. A. S. Worcester as to what exactly was the point in using crude oil, Mr. Griffiths said that for the making of cores he had begun by using core oil, but the cost of core sand, exclusive of labour, worked out at 2s. 3d. per cwt. It was rather in a spirit of desperation at the cost that they tried crude oil, which they had in a tank, and they found it worked satisfactorily. They had, however, come to the conclusion that it was more expensive than coal dust for facing sand, and coal dust served quite as well.

Waster Percentage Reduced

Mr. Scanlon said there were several advantages in the use of Belgian sand which he would like to urge. Its use permitted—in fact, required—a much cleaner foundry, and he thought that was in itself an advantage both from the aspect of better work and happier conditions for the workers. Another factor was that the foundry using Belgian sand was not so dependent on the skilled moulder as that using English sand, because any reasonably intelligent man who would follow simple instructions in connection with ramming it up could be employed in the use of this sand. Moulding with Belgian sand was more certain and the "flop-outs" were much fewer than with English sand. Mr. Griffiths had made no mention of the question of scrap, but they all knew what an important factor this was. Since their firm used Belgian sand their scrap percentage had become very greatly reduced in proportion to the greater percentage of good castings.

Vote of Thanks.

Mr. A. S. Worcester proposed a vote of hearty thanks to the lecturer.

Mr. R. D. Welford, in seconding, said he admired very greatly the results which Mr. Griffiths had achieved by the use of this sand, but he was afraid Mr. Griffiths' very modern and refined methods were not easily applicable to something like 95 per cent. of the foundries of this country. They would, however, all congratulate him on his boldness in sticking to this sand and these methods, and they were bound to admit that he had produced convincing evidence of success.

Welded Bedplates.

According to "The Welder," the advantages of the welded bedplate over the casting are as follow:—(1) No patterns are required, and, in cases where fresh designs are being made, a considerable loss of time is thus eliminated; (2) a lighter article is produced. Comparative figures from a number of different works show that the average saving in weight between a welded and a cast-iron bedplate is approximately 15 per cent. for small bedplates and up to 25 per cent. for large ones; (3) rigidity can be obtained without having to add heavy masses of metal. The discreet use of gussets and stiffeners welded rigidly in the correct place will produce as rigid a structure as any casting can give with the minimum amount of metal; and (4) the welded-steel bedplate is very much less liable to damage than a cast-iron bedplate. This is more particularly the case where the bedplate is for use with a portable plant or where it may have to be sent for considerable distances before erection.

The advantage of the welded bedplate over the riveted steel bedplate scarcely needs comment. If there is any one outstanding necessity in a bedplate it is rigidity, and it will at once be obvious that no method of riveting can compare with welding methods in this respect. In the United States, progress has been made to such an extent with bedplates of the welded type that on some ships recently built the whole of the auxiliaries were mounted on welded-steel bedplates, cast iron being completely eliminated for this purpose.

The X-Ray Examination of Castings.

In the course of a Paper on "X-rays in Engineering Practice," presented to the Institution of Mechanical Engineers on December 12, Dr. V. E. Pullin, Director of Radiological Research, Research Department, Woolwich, said that it should be very clearly understood that radiographic examination is expensive, and therefore is not an economic proposition for all castings as a routine matter, although in the case of very high-grade material, where lightness and soundness are of paramount importance, it may even pay to conduct an examination of every casting. On the other hand, X-ray examination should prove of the greatest value in a foundry where castings of new and complicated design could be examined on the spot for weak areas and faulty technique. It is the definite experience of the author that valuable time may be saved by the use of X-rays at the appropriate moment in the foundry.

Considering the practical application of X-rays, it is obvious that a universal routine of 100 per cent. examination of castings is out of the question by reason of its cost and the time involved in the operation. On the other hand, information may often be obtained from a radiograph that is obtainable in no other way. There are certain cases where specific knowledge as to the soundness of materials is essential and must be obtained if possible in spite of the somewhat heavy cost involved. High-grade castings, where saving of weight is of the greatest importance, must be sound, and in such cases it may very well pay to X-ray the whole of every casting. In other cases only suspected areas or regions of severe stress may be selected for X-ray examination. An X-ray plant could very profitably be installed in every foundry of any size. Castings of new and complicated design very often give serious trouble in the first batches. Casting practice is by no means so perfect that the cause of failure can be detected at once, and valuable time is often wasted in rectifying faulty technique or design. If the first casting of a new design were X-rayed as a matter of course the weak and faulty areas would immediately become apparent and their detection would at once suggest the remedy. This, in the author's opinion, is one of the most important developments in foundry practice and one that will surely be universally adopted when X-rays become more familiar in the engineering world.

One of the most important questions that arises in the mind of the prospective user of X-rays is the cost. It is not easy to specify it. Actually all heavy engineering X-ray work is photographic, as visual examination by means of a fluorescent screen is not often possible. Consequently one of the chief items to consider is the cost of the film. This works out together with development at about 1s. 6d. per sq. ft. The capital cost of the equipment may be anything from £500 to £1,000, depending upon power and installation facilities. Depreciation is low and running costs for power and consumption almost negligible. The cost of the film may be appreciably reduced by the use of specially-made sensitised paper which has the disadvantage of requiring something like twice the exposure; but by its use the cost is reduced to about 6d. per sq. ft. Great improvmeents have recently been made in the manufacture of this paper, and its use in industrial radiography will probably become general.

The Stirling Boiler Company, Limited, 32, Farringdon Street, London, E.C.4, have obtained an order for plant required for extensions to the North Point Power Station of the Hong Kong Electric Company, Limited, comprising two tri-drum boilers each having a heating surface of 9,814 sq. ft., complete with economisers, air heaters, mechanical stokers, forced- and induced-draft plant, ash-handling plant, etc.

A Co-operative Buying and Selling Scheme.

What we believe is the first co-operative buying and selling organisation within the foundry industry emanates from South Wales, and a company called United Engineers & Founders, Limited, has been registered as a private company, with a nominal capital of £100 in 1s. shares. The objects are to establish and carry on a selling and buying agency for and on behalf of persons, firms, corporations and companies engaged in the engineering, foundry, building industries, etc., and to adopt an agreement with Taylor & Sons, Limited, Llanelly Foundry & Engineering Company, Limited, Thomas & Clement, Limited, Richard Nevill & Company, Limited, and Glanmor Foundry Company, Limited.

Each of the five above companies may appoint one director. The directors are: F. J. Taylor (appointed by Taylor & Sons, Limited), A. J. Burn (appointed by Llanelly Foundry & Engineering Company, Limited), W. E. Clement (appointed by Thomas & Clement, Limited), F. H. Treherne Thomas (appointed by Richard Nevill & Company, Limited), W. J. Rees (appointed by Glanmor Foundry Company, Limited).

All the foundries concerned, except Messrs. Taylor & Sons, Limited, of Briton Ferry, are situated at Llanelly. We expect that the new company will want to create a library of catalogues, and suggest that the suppliers of plant and material to the foundry industry should send their publicity matter to the company, care of 9, Royal Metal Exchange, Swansea.

News from the Branches.

JOHN SURTEES MEMORIAL COMPETITION.

The Newcastle Branch of the Institute of British Foundrymen is now engaged upon making final arrangements for the 1931 examination in connection with the above competition. The examination is in two parts—Senior and Junior—open to members, associate members and associates of the Newcastle Branch. In the Junior section, however, the Governors have power to consider applications from foundry apprentices living in the district who are not members of the Branch. The examination will be held in January, and application forms can now be obtained from the secretary of the Newcastle Governors, Mr. F. Sanderson, 1, Ellwood Gardens, Gateshead. All entries must be received not later than December 31, 1930. Mr. J. W. Frier (Past Branch-President) has been elected chairman of the Newcastle Governors in succession to the late Mr. J. D. Carmichael.

Foundry Query.

A reader requires the composition of "Ferac."

The work of construction arising out of the naval programme for the present year is to be spread over as wide a field as possible, in view of the distress in all the shipbuilding areas. One cruiser and one destroyer leader are to be built at Portsmouth Dockyard, one cruiser and three sloops at Devonport, and two small submarines and a net-layer at Chatham. The other vessels included in the programme are to be built in private yards, one cruiser with machinery by Messrs. Cammell Laird & Company, Limited, Birkenhead, two destroyers and a set of machinery by Messrs. Vickers, Limited, Barrow, two destroyers and a set of machinery on the Clyde, two destroyers and a set of machinery on the Tyne, and two destroyers at Southampton. The total cost of the whole programme, including the ships to be built in the Royal Dockyards, is estimated at £9,500,000.

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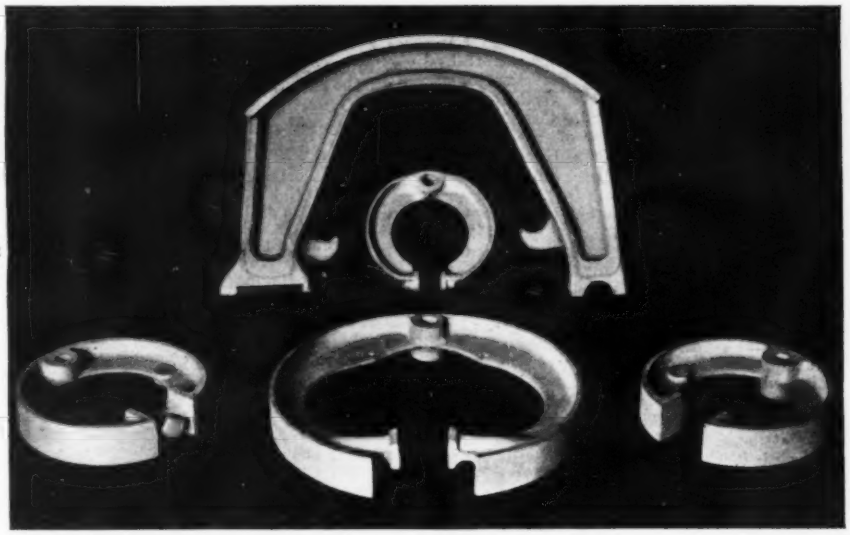

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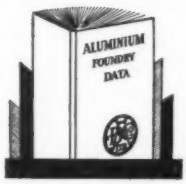

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Trade Talk.

THE GOVERNMENT have decided to despatch a trade mission to Egypt early in the New Year. It will be under the chairmanship of Sir Arthur Balfour.

THE DAGENHAM DOCK STEEL FOUNDRY, LIMITED, of Dagenham Docks, Essex, at their meeting on December 15, recommended a payment of an interim dividend of 10 per cent., tax free.

THE NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED, of Springburn, Glasgow, have received a contract for six Mikado-type engines and tenders for service on the Peuping-Liaoning Railway, China.

THE NUMBER of vessels launched on the Tyne during the 11 months of this year was 59, of 305,446 tons gross, compared with 65 vessels and 243,843 tons in the corresponding period of last year.

IT IS UNDERSTOOD that the Engineering and Allied Employers' National Federation have sent an invitation to some 50 trade unions concerned in the engineering industry to a conference to be held in January to consider wages and working conditions.

THE BRITISH IRONFOUNDERS' ASSOCIATION has been formed to replace the old National Light Castings Association. The President is Sir Gervais Rentoul, K.C., M.P. Mr. W. R. Blair is chief executive officer and Mr. J. Galbraith Sneddon is secretary. The offices of the Association are at 100, Wellington Street, Glasgow, C.2.

THE GOODWILL, patterns and trade name of Messrs. John McDowell & Sons, Limited, Johnstone, Renfrewshire, have been acquired by Messrs. Thos. White & Sons, Limited, Laighpark Engineering Works, Paisley. The work previously carried out in Johnstone will be transferred to Paisley. Both firms specialise in the manufacture of wood-working machine tools and sawmill engineering.

THE FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Govan, Glasgow, are to build the hull and machinery for two destroyers for the British Admiralty. Messrs. William Beardmore & Company, Limited, Dalmuir, will build the machinery for a flotilla leader which will be built at Portsmouth. These contracts are part of the Admiralty's 1930 programme, and are particularly welcome at Fairfield, where only about 10 per cent. of the normal staff have been employed for some time.

CONTRIBUTIONS TO INFIRMARIES and other charitable institutions in the West of Scotland have been made by employees of the following firms :—Messrs. Barr & Stroud, Limited, Anniesland, £137; Cyclops Foundry & Patternmaking Company, Limited, Glasgow, £28; Torwood Foundry, of Messrs. Jones & Campbell, Limited, Larbert, £213; Messrs. Shaw (Glasgow), Limited, Maryhill Iron Works, £306; Etna Iron & Steel Company, Limited, Motherwell, £103; and Messrs. James Howden & Company, Limited, Glasgow, £246.

AN ARRANGEMENT has been made between Messrs. Edgar Allen & Company, Limited, Sheffield, and the Allis-Chalmers Manufacturing Company, of Milwaukee, U.S.A., under which the former will manufacture at Sheffield and sell in certain parts of the British Empire and Asia various types of Allis-Chalmers crushing and grinding machinery. The arrangement does not apply to Canada, and the sales organisation of the Allis-Chalmers Manufacturing Company in Paris, London and South Africa will not be affected in any way, but firms in the crushing, grinding and cement industries will have in many instances the advantages of the combined technical resources of the two companies together with British manufacture should they prefer it.

AT THE RECENT general meeting of the Klöckner-Werke, of Duisberg, Herr Peter Klöckner said that the technical improvements and the rationalisation of works, which were forced by the increasing wages and salaries, as in America, now constituted a valuable asset and would make themselves felt in the course of the next few years. The world's crisis, the speaker said, had been caused by the great difference between consumption and production, for which reason endeavours were being made to effect drastic curtailments in production, which in America and Germany amounted to about 50 per cent. In view of the impoverished state of Germany and her inability to obtain credits on reasonable terms, a reduction in iron and steel prices could not bring about an increased demand in the home markets. She was therefore compelled to increase her exports. The iron and steel prices ruling in the home markets could not be compared with export prices, as the world's market prices were much below production costs in all countries and could not be maintained at their present level. Even France, Belgium and Luxemburg, which, as a result of lower wages, salaries, taxes and social charges, had an advantage of 30 mks. per ton with regard to costs of production, were compelled to export at a loss.

ARRANGEMENTS HAVE recently been made in connection with the development of stainless steel by the co-operation of the Sheffield Stainless Steel Manufacturers' Association with the Firth-Brearley Stainless Steel Syndicate, Limited. Customers of the steelmakers who are members of the Association may, under licence from the Firth-Brearley Stainless Steel Syndicate, Limited, export articles made from stainless steel to all the foreign countries where their patents are in force. In connection with this co-operative measure an agreement has been arrived at with the Krupp concern, which controls the patent position in Germany, for the elimination of competition in the British Isles in stainless steel and articles made therefrom by German, Austrian and Czecho-Slovakian manufacturers. The present members of the Sheffield Stainless Steel Manufacturers' Association are :—Thomas Firth & Sons, Limited; Brown Bayley's Steel Works, Limited; Edgar Allen & Company, Limited; Burys & Company, Limited; Vickers, Limited, Armstrong, Whitworth & Company, Limited, and Cammell Laird & Company, Limited, branches of the English Steel Corporation, Limited; Hadfields, Limited; Wm. Jessop & Sons, Limited; Jonas & Colver (Novo), Limited; Kayser Ellison & Company, Limited; Samuel Osborn & Company, Limited; J. J. Saville & Company, Limited; Sanderson Brothers & Newbould, Limited; and Arthur Balfour & Company, Limited.

Contracts Open.

Abingdon-on-Thames, January 3. — Pumping station, cast-iron mains, etc., for the Abingdon Rural District Council. Mr. G. Allsebrook, engineer, 29, Crown Street, Reading. (Fee £3 3s., returnable.)

Cairo, February 2.—Centrifugal pump, steel and cast-iron piping, etc., for the Egyptian Ministry of the Interior. The Department of Overseas Trade. (Reference A.X. 10,638.)

Charlesworth, Glossop, December 29.—560 yds. of cast-iron water main, for the Glossop Dale Rural District Council. Messrs. Brady & Partington, civil engineers, Chapel-en-le-Frith. (Fee £1, returnable.)

Dublin, January 13.—Pair of steel dock gates, for the Dublin Port and Docks Board. The Engineer's Office, East Wall, Dublin, C.10.

Filey.—Cast-iron pipes and specials, for the Filey Urban District Council. Mr. H. E. Bloor, consulting engineer, Clifton, York.

London, E., January 5.—90 tons of cast-iron pipes, for the London County Council. The Chief Engineer, Old County Hall, Spring Gardens, S.W.1. (Fee £1, returnable.)

London, E.C., January 2 and 23.—(1) Pig-iron and (2) galvanised steel and ironwork, for the Bombay, Baroda and Central India Railway, the White Mansion, 91, Petty France, Westminster, S.W. (Fee 10s., non-returnable.)

London, N., January 16.—Cast-iron pipes, etc., for the Borough Council. The Town Clerk, Town Hall, Upper Street, Islington, N.1.

London, W., January 6.—Iron and steel goods, for the Great Western Railway. The Stores Superintendent, Swindon.

Port Elizabeth, S.A., January 8.—Five centrifugal pumps, for the Municipality. The Department of Overseas Trade. (Reference A.X. 10,634.)

St. Mawes, Cornwall, January 3.—Pumping plant, for the Truro Rural District Council. Mr. L. D. Haworth, consulting engineer, 3, Central Buildings, Westminster, S.W.1. (Fee £5, returnable.)

Wills.

BREEN, J. T. F., of Glasgow, iron and steel merchant	£9,775
GOLLANCE, LEONARD, metal merchant, a partner in Messrs. Philipp & Lion, London	£27,473
BARNES, ERNEST E., of Chesterfield, lately chairman of the Grassmoor Company, Limited	£89,082

Reports and Dividends.

United Steel Companies, Limited.—The directors have decided not to declare an interim dividend.

Whitehead Iron & Steel Company, Limited.—Interim dividend on the ordinary shares at the rate of 10 per cent. per annum.

Atlas Steel Foundry & Engineering Company, Limited.—Profit, £4,144; brought in, £2,184; debenture sinking fund, £1,500; depreciation, £1,500; carried forward, £3,128.

Stewarts & Lloyds of South Africa, Limited.—Trading profit, £67,651; depreciation, £27,302; written off preliminary expenses, £3,388; brought in, £2,142; preference dividends, £35,500; carried forward, £3,603.

Consett Iron Company, Limited.—After providing for debenture interest, but not for depreciation, there is a profit for the half-year ended September 30 last, but the directors do not feel justified in paying any interim dividend on the ordinary and preference shares.

Redpath, Brown & Company, Limited.—Profit, after providing for depreciation, £71,730; brought in, £45,862; preference dividend, £10,500; final dividend on the ordinary shares of 4 per cent., tax free, making 12½ per cent., tax free; staff pension scheme, £2,000; carried forward, £47,343.

New Companies.

Britannia Lead Company, Limited.—Capital £100,000. Solicitors: Slaughter & May, 18, Austin Friars, London, E.C.

Coventry Metallurgical Company, Limited, 2, Stoneleigh Terrace, Coventry.—Capital £10,000. Directors: F. W. Miles and F. W. Miles, jun.

D. Parker & Sons, Limited, Excelsior Steel and File Works, Ecclesfield, Sheffield.—Capital £12,000. File and steel manufacturers, etc. Directors: D. Parker and W. N. Parker.

Armstrong Bros. Tool Company, Limited.—Capital £8,000. Directors: E. P. Barrus (chairman and managing director), 2, Peek Crescent, Wimbledon, London, S.W.; and H. F. Barrus.

Company Meeting.

Power-Gas Corporation, Limited.—The annual meeting of the Power-Gas Corporation, Limited, was held in London on December 16. MR. E. LLOYD PEASE (chairman), who presided, said that they had been able to keep most of their men employed at Stockton, mainly because they were supplying appliances of production to Japan, Russia and South Africa. Engineering orders for the home market were difficult to procure. The principal exception in this country was Henry Ford's outstanding enterprise at Dagenham, on the Thames, with which they were associated due to the connection they had made with the Freyn Engineering Company, of Chicago. Referring to some of the chief contracts, the chairman said that the blast-furnace plant at Dagenham had gone on well during the year. It would be finished next year. They had obtained two important contracts in South Africa, one through the Imperial Chemical Industries, Limited, and the other a blast-furnace plant for the South African Iron & Steel Industrial Corporation, Limited. The former was well advanced and the latter was in initial stages only. They had in hand an important gas plant for Russia of more than £100,000. As to the future, the view of the management was that the present outlook justified anticipating a fairly satisfactory year.

Obituary.

MR. DAVID KING, J.P., director of Messrs. David King & Sons, Limited, Keppoch Ironworks, Possilpark, Glasgow, died suddenly at his home in Glasgow on December 8, aged 74.

MR. GEORGE WEST, chief engineer to Messrs. William Braby & Company, Limited, Petershill Road, Glasgow, died on December 18 in London whilst travelling in a Metropolitan train.

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Sir Robert Hadfield's advice!

Speaking to the Colonial Premiers and others when they visited Hadfield's Steel Foundry on November 7th, Sir Robert said:

"I appeal to all present to support British manufacturers in every possible way . . . . . We can do a great deal amongst ourselves by mutual help and co-operation. British Steelmakers can give you the best steel for every purpose, and in these days it pays to use none but the best.

What is true of the steel industry is equally true of other industries in this country, BEFORE YOU BUY FOREIGN PRODUCTS OR PLACE ORDERS ABROAD—MAKE SURE YOU CANNOT OBTAIN AT LEAST AS HIGH QUALITY AND GOOD VALUE IN THIS COUNTRY."

WILL YOU DO AS SIR ROBERT SAYS?

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the market for Cleveland iron during the current week have been more subject to the holiday-season influence than to the business of buying and selling, and consequently there is very little of interest to add to previous reports. Generally speaking, consumers of Cleveland pig-iron have covered their needs to the end of the year, and only in odd cases has it been necessary to make further purchases to meet current requirements. In a few instances tentative inquiries are being circulated for supplies over the early months of next year, but buyers are slow to place definite orders. Expectations of a further cut in prices may or may not be justified by events, but they are certainly widely entertained. The specially low prices quoted to Scottish buyers have, of course, prevailed for some time past, but no concessions have been made in other quarters, and, in view of the wide disparity between local and foreign pig-iron prices, consumers seem to be determined to hold out for a readjustment of prices in their favour. That, however, is a question that only the future will decide, and meantime prices remain firmly fixed at the following minimum rates:—No. 1 Cleveland foundry iron, 66s. per ton; No. 3 G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; No. 4 forge, 62s. per ton.

In the market for East Coast hematite it is satisfactory to report that there are now definite grounds for hopes of expansion in the demand for this grade of iron. The current output is being promptly absorbed by running contracts, and stocks are being slowly, but steadily, reduced. The prevailing view is that prices are likely to move upwards; indeed, rather higher figures are quoted for forward than for prompt, and, as usual when the market shows a rising tendency, buyers are keener to do business. For immediate delivery, sellers are prepared to accept 70s. 6d., but 71s. is a firm figure for January, with No. 1 at 71s. 6d. per ton. On the North-West Coast, Bessemer mixed numbers are quoted at 70s. per ton, at works.

LANCASHIRE.—Until the current week there has been no falling-off in the tonnage of iron taken against running contracts, and, although buying on forward account has been slow of late, business generally in local markets has been a little more promising than was expected. Prices remain stationary at the official rates, Derbyshire and Staffordshire No. 3 being on offer at 69s. 6d. per ton, and Northamptonshire iron at 68s. Scotch foundry iron is attracting little attention, and quotations are on the easy side at from 90s. 6d. to 91s. per ton, delivered local stations.

THE MIDLANDS.—Consumers of foundry pig in this area are at the moment limiting purchases to the minimum scale, and, until the year has turned, little change in the general conditions of local trade can be anticipated. Prices will be under discussion again by the pig-iron producers in January, but meanwhile consumers are not at all anxious buyers, and very few are prepared to come into the market for the first quarter of the New Year. Current quotations for all grades of foundry pig remain as previously quoted, all inclusive of delivery to local stations.

SCOTLAND.—The pig-iron market continues featureless. Business is very slow. The Scottish ironmasters, while reducing the price of forge iron by 6d. per ton recently, made no change in the price of foundry iron, which remains on the basis of the official minimum of 76s. 6d. for No. 3 at the furnaces, with 2s. 6d. per ton extra for No. 1. In view of stocktaking, the founders are reducing their already curtailed demand for pig-iron.

Finished Iron.

This market remains very depressed, and there does not seem to be any prospect of early improvement. None of the works is in a position to keep its mills operating regularly, and the Staffordshire mills are having to fight very hard to keep going even in an irregular fashion. They are meeting with competition for crown bars from Lancashire and other mills, which are underquoting the local figures of round about £10 per ton. For good crown iron from the outside works £9 15s. is being quoted. The price of nut and bolt iron from the local mills is £8 15s. to £9 per ton, but the demand cannot be anything but spasmodic in view of the continued low rates at which Belgian and French works are prepared to accept business. Their prices at the moment delivered this district are round about £5 7s. 6d. The makers of Staffordshire marked bars continue to be moderately occupied, although they are not so busy as they were a month or two ago. Their price is unchanged at £12 10s. at works.

Steel.

In the Sheffield steel market last week the position appeared to show some slight improvement, and business in billets, both basic and acid, which had sunk to a low ebb, was reported to be a little better. Wire-rod business is not good, and makers are still facing much competition from the Continent. Bright-drawn steel is an improving feature. Prices are unchanged, and are:—Siemens acid billets, £9 10s.; basic billets, soft, £6 10s.; medium, £7 12s. 6d.; hard, £8 2s. 6d. to £8 12s. 6d.; wire rods, acid, £12 5s. to £12 10s.; basic, soft, £8; medium, hard, £9 15s. to £10; hard, £10 10s. to £11; steel hoops, £10. The tinplate market remains quiet, with coke quality quoted on the basis of 15s. 9d., net cash, f.o.b. South Wales ports.

Scrap.

In anticipation of the holidays, demand for scrap on Tees-side has decreased once more, and arrangements have been made for curtailment of deliveries until after the New Year. Ordinary heavy cast iron remains unchanged at 50s. per ton, but there is a very limited demand, and this also applies to good machinery quality at 52s. 6d. per ton. At Birmingham last week heavy cast machinery scrap was quoted 60s., light cast iron 45s. and heavy pipe and plate scrap 57s. 6d. per ton. In Scotland all classes of cast-iron scrap continue to be extremely difficult to sell. Steelworks cast-iron scrap in handy pieces is quoted 50s., with first-quality machinery cast-iron scrap 55s. to 57s. 6d. Ordinary metal to the same specification is 51s. 3d. to 52s. 6d. Cast-iron railway chairs are 55s. to 56s. 3d. Light metal is 40s., with furnace firebars at 2s. 6d. less. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—The tendency of values in last week's markets evidenced some irregularity, following developments in the American position. Representative copper stocks on Wall Street were very much depressed, and the whole tone of the markets on both sides of the Atlantic was weak. The American statistics published recently did not help matters much, the most favourable points being a reduction of 15,000 tons in reserves of blister copper and a fall of about 5,000 tons in production.

Closing quotations:—

Cash.—Wednesday, £43 12s. 6d. to £43 15s.; Thursday, £45 2s. 6d. to £45 5s.; Friday, £45 10s. to £45 12s. 6d.; Monday, £47 5s. to £47 6s. 3d.

Three Months. — *Wednesday*, £43 10s. to £43 11s. 3d.; Thursday, £45 to £45 2s. 6d.; Friday, £45 5s. to £45 7s. 6d.; Monday, £46 18s. 9d. to £47.

Tin.—The price has now given way to a new low record, and looks as if it may react further, the immediate cause of this fresh weakness being an announcement that 3,000 tons of unsold tin will be shipped from Batavia by the Dutch Government this month. Such an addition to the visible supplies at a time like the present cannot fail to depress values and to make matters worse. It is announced that a further 2,000 tons may follow.

Official closing prices:—

Cash.—Wednesday, £104 10s. to £104 12s. 6d.; Thursday, £105 17s. 6d. to £106; Friday, £105 15s. to £106; Monday, £114 2s. 6d. to £114 5s.

Three Months.—Wednesday, £105 12s. 6d. to £105 15s.; Thursday, £107 2s. 6d. to £107 5s.; Friday, £107 to £107 2s. 6d.; Monday, £115 10s. to £115 15s.

Spelter.—In the absence of demand, this market has continued a drift towards lower levels, and it looks very much as if £13 will be reached, and perhaps broken. Buyers seem indifferent and sentiment is adverse, in view of the heavy decline in other metals. There has been some inquiry for high-grade metal.

Daily fluctuations:—

Ordinary. — Wednesday, £13 5s.; Thursday, £13 10s.; Friday, £13 11s. 3d.; Monday, £13 16s. 3d.

Lead.—There was a decline of about 12s. 6d. last week, but the market has shown a fairly steady front, in spite of adverse influences. Rumours regarding a further decline in tin are rife, and it must be admitted that warehouse stocks are heavy.

Soft Foreign (Prompt).—Wednesday, £14 12s. 6d.; Thursday, £14 16s. 3d.; Friday, £14 16s. 3d.; Monday, £15.

Students' Corner.

Q.—What are considered good methods to follow regarding runner-gates when pouring iron castings?

A.—The position of runner-gates in relation to a casting and the best methods of pouring cannot be practically dealt with here, but some general rules may be laid down that may profitably be remembered. (1) The in-gates and down-gates determine the rate of pouring which should not be greater than is necessary to keep the pouring basin full when running the casting; (2) There is an area relationship between in-gates and down-gates that should be considered. The pressure of the metal when pouring is best checked by the area of the down-gate, or a connected horizontal passage-gate rather than by the in-gates to the casting. If the pressure of the flow of the metal is checked by the in-gates, there would be an undesirable commotion of the fluid metal in the region of the mould where metal enters causing much erosion, strains and possible scabbing. The last remark does not apply to castings gated on the top—that is, vertical in-gates; (3) The actual position and area of runner-gates depend often upon shop conditions, design and weight of the casting. An in-gate should not impinge on the mould or cores if it can be possibly avoided; when such cannot be avoided there is a danger that either the mould or core will suffer due to scabbing, unless the wash of the metal is counteracted by means of sprigging or shielding the part impinged upon. In addition, the regularity of the flow of metal is hindered as the mould is filling; (4) Speaking generally, when convenient, a distribution of in-gates is advisable providing the proper sizes are used. On many castings of irregular design two small in-gate runners are better than one large one, the total area of gate being the same; or four smaller ones are better than two larger ones, and so on. The advantages are that the possibility of porous areas and draws due to local hot spots are minimised, also by dividing the stream or flow of the metal affords the escape of possible occluded or dissolved gases, besides by so doing assistance is given to uniform cooling which is desirable in all castings; (5) Arrange the in-gates whenever practical for the flow of the metal to get clear away into the mould and thus prevent the formation of eddies," "fountains," or "reservoirs" in the mould near the in-gates, thus dross areas and segregations will be avoided.

There may be exceptions to this where some forms of bottom runner-gates are practised, but in all forms of top running, that is, in-gating on the top of the casting, small runners are preferable to large ones. Good advice is to avoid extremes. In many cases, although it is always a temptation, it is not wise to in-gate into the thick part of a casting, but when practicable in-gate into the thinner parts, which would again assist uniform cooling and minimise segregation.

(To be continued.)

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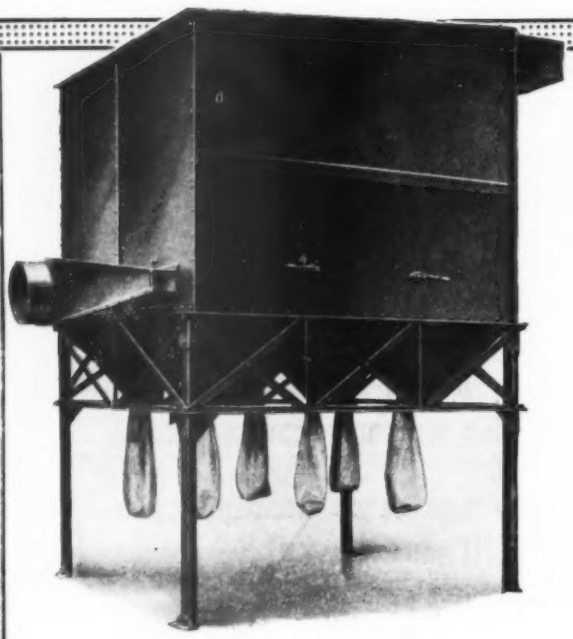

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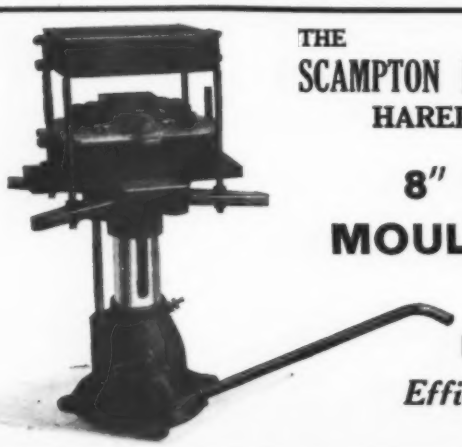

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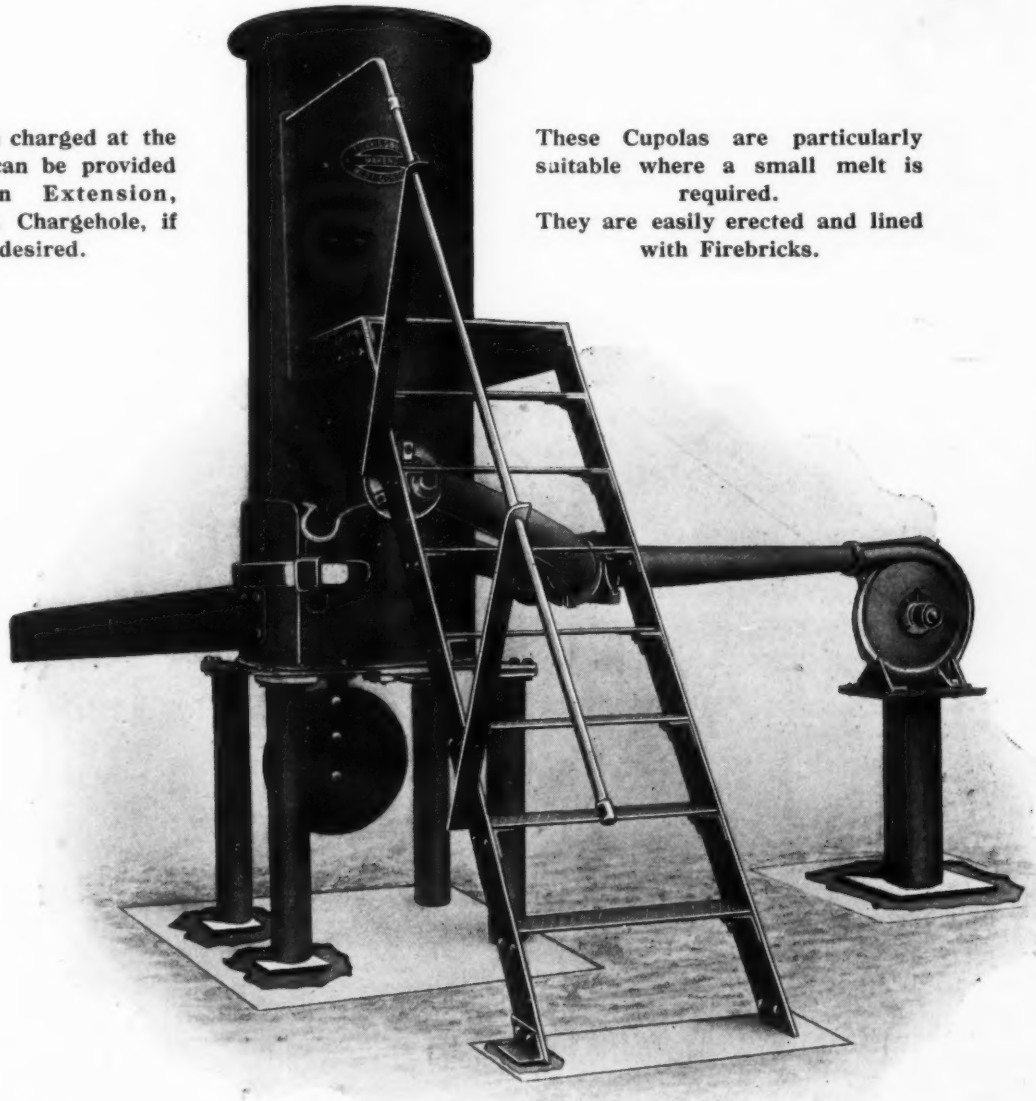

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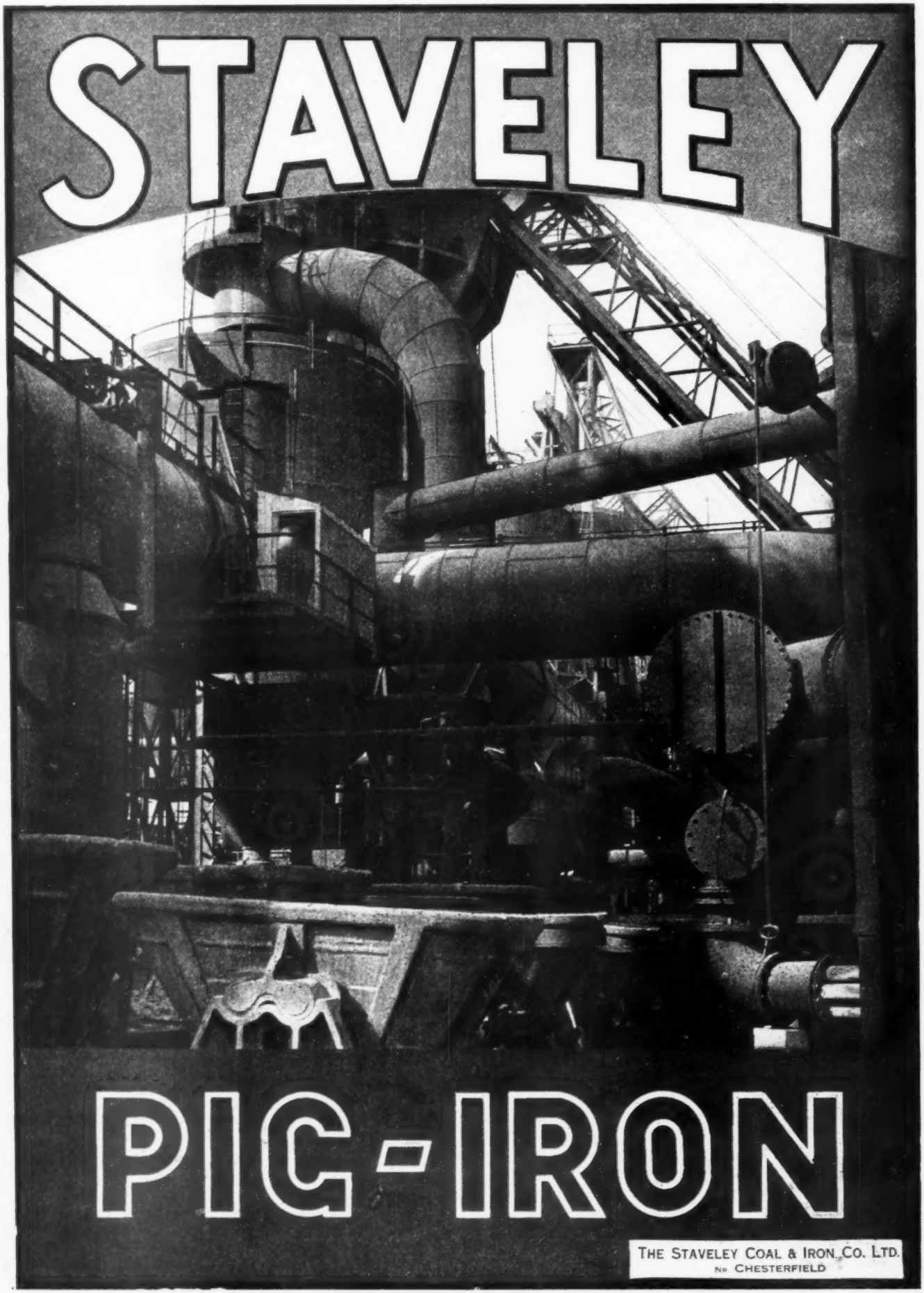
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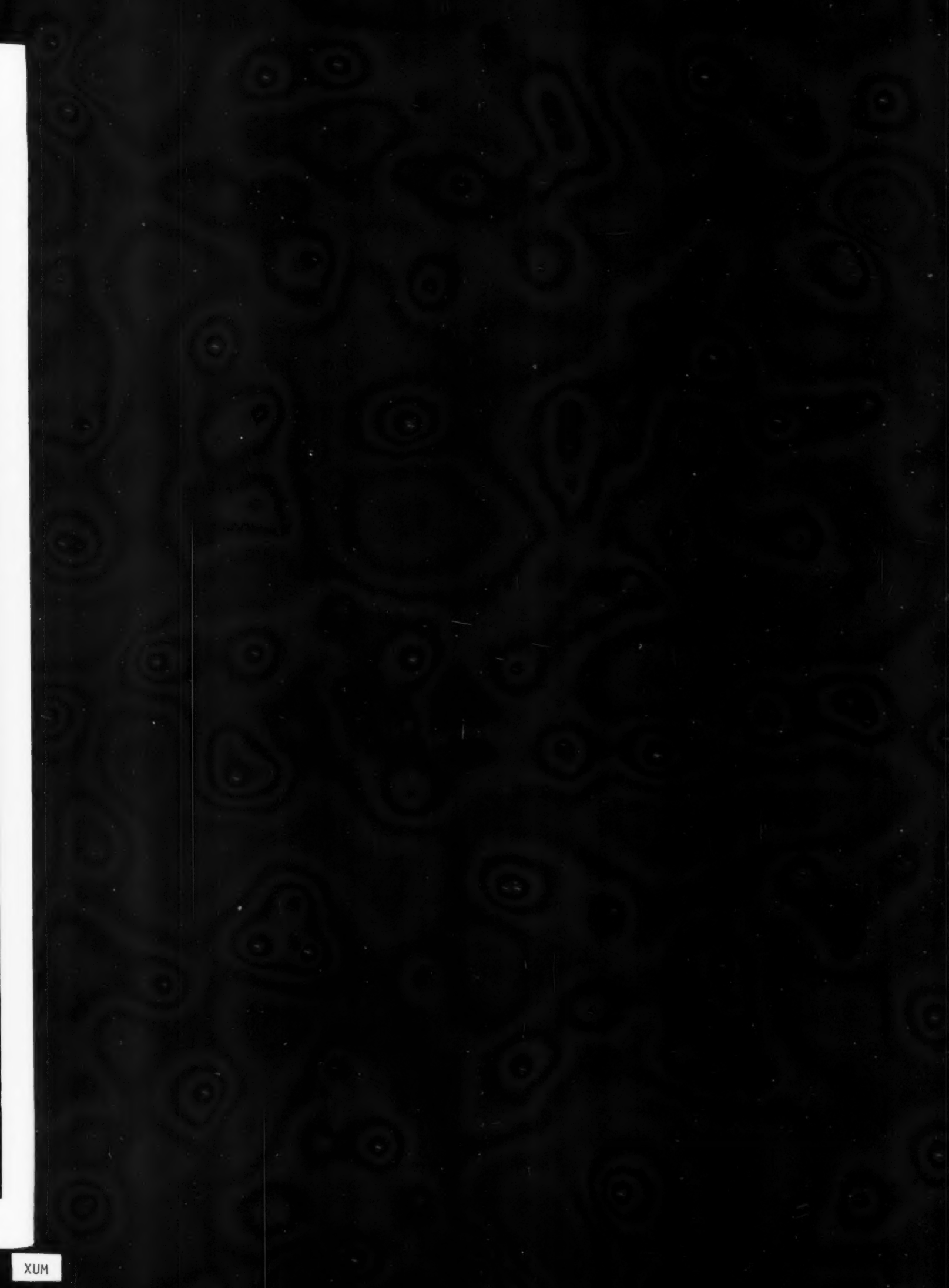

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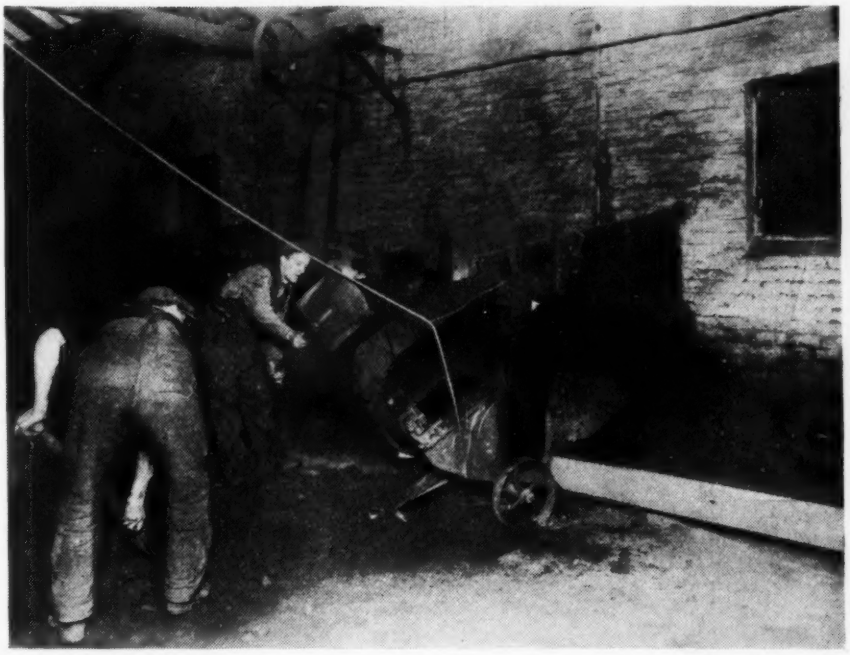

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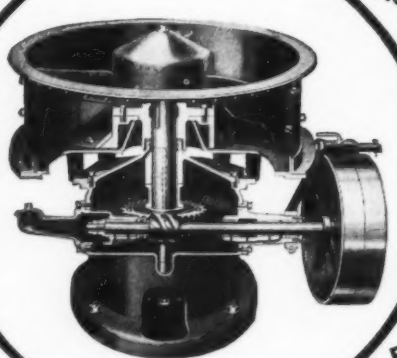

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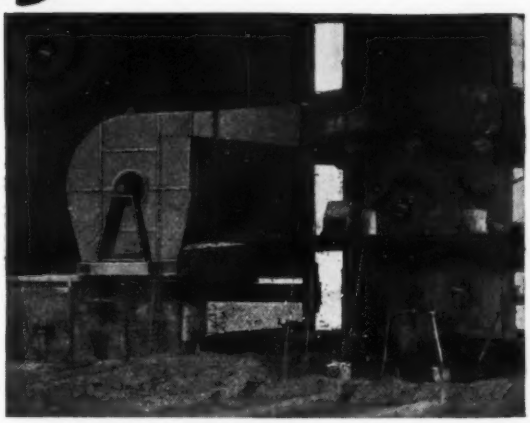

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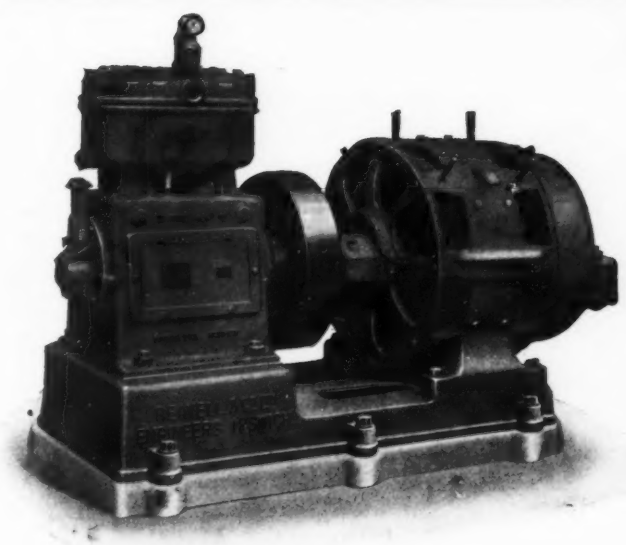

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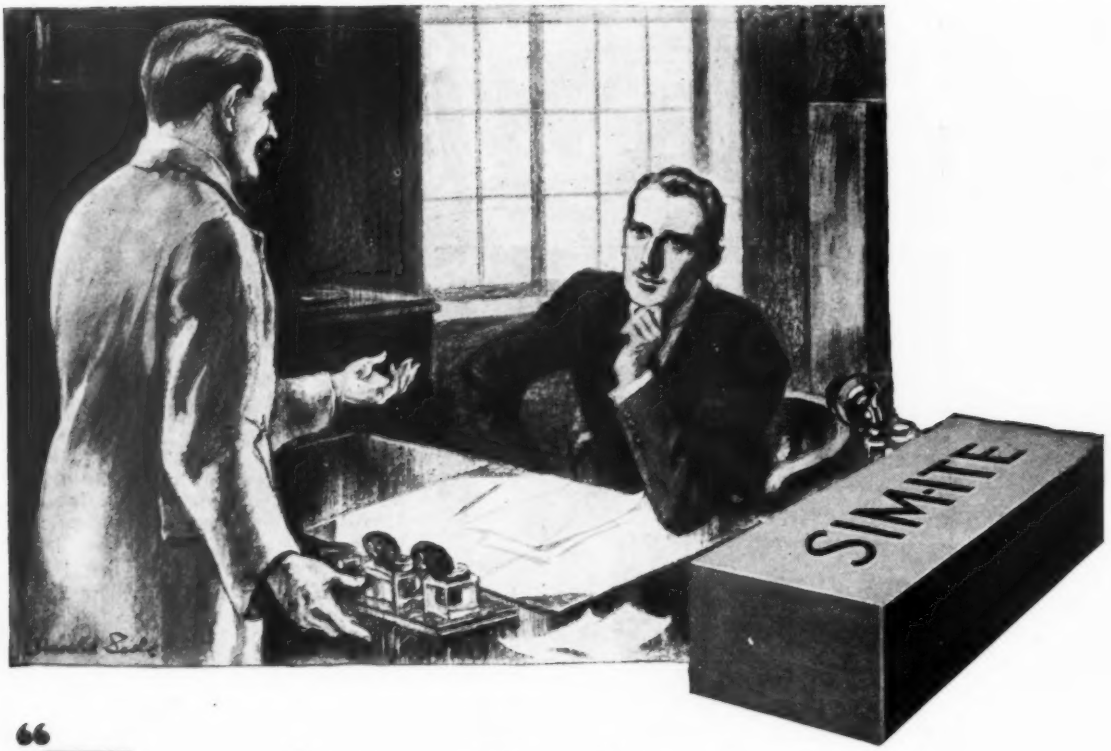

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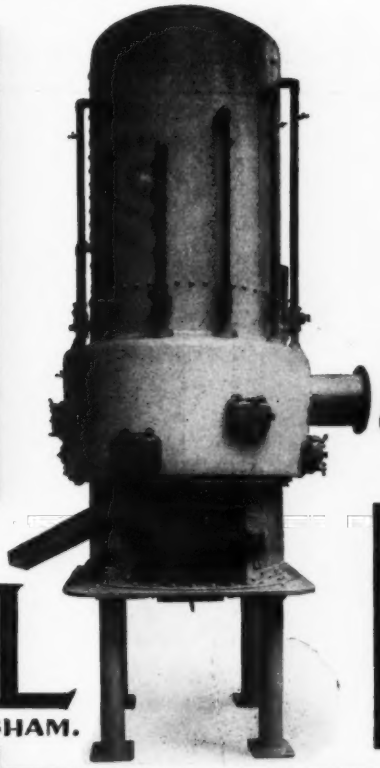

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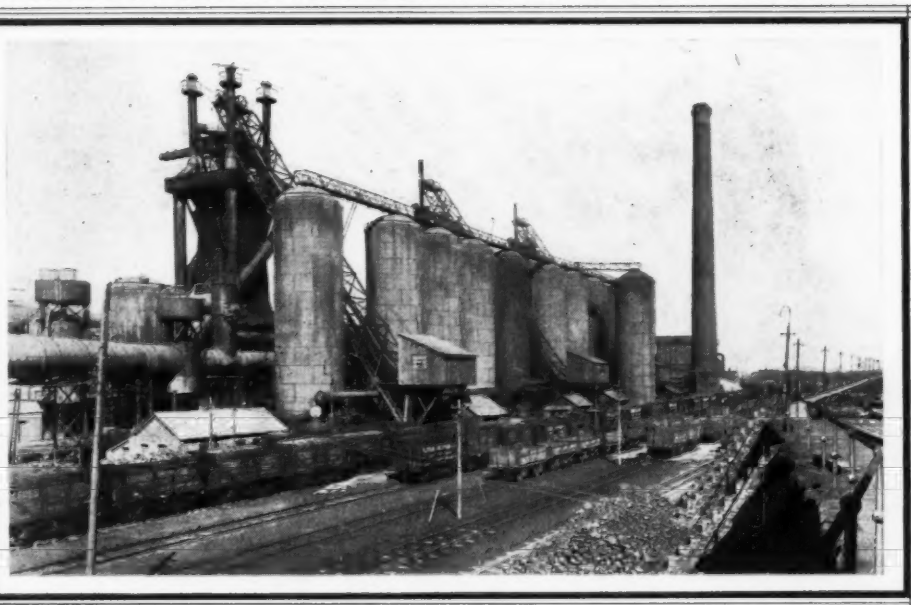

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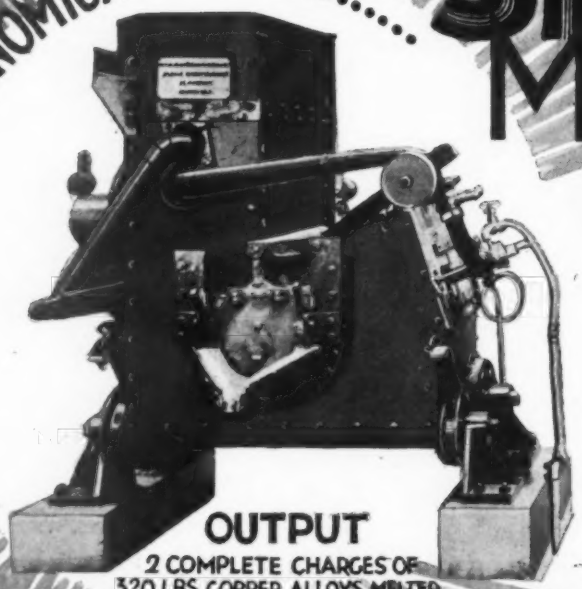

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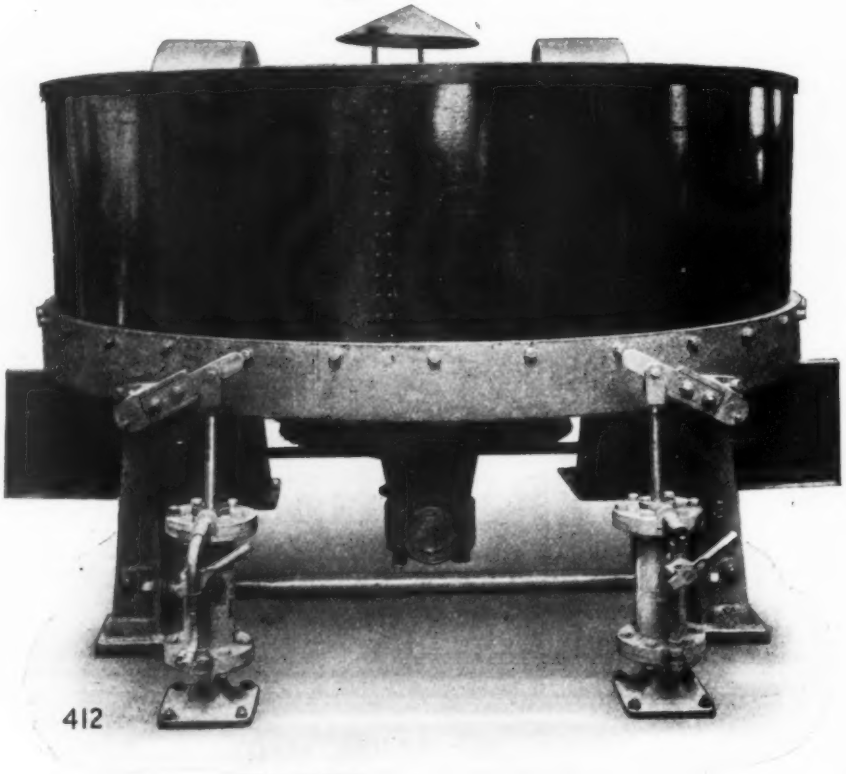
Stewarts & Lloyds, Ltd.	11
Taylor & Farley	—
Tennent R. B., Ltd.	25
Tilghman's Air Compressor Co.	—
Tilghman's Patent Sand Blast Co., Ltd.	4
Townley, E., & Sons	—
United Carborundum and Electrite Works Co.	—
United Steel Companies, Ltd., The	—
Universal System of Machine Moulding & Machinery Co., Ltd.	—
Vickers, Thos., Ltd.	—
Walker, I. & I.	—
Wallwork, Hy., & Co.	—
Ward, Thos. W., Ltd.	20
Warner & Co., Ltd.	—
Waring Bros.	—
Watson's (Metallurgists), Ltd.	24
Welsh Navigation Steam Coal Co., Ltd.	—
Whittaker, W., & Sons, Ltd.	—
Wild-Barfield Electric Furnaces, Ltd.	—
Wilkinson, Thos., & Co., Ltd	—
Wilson Products, Ined.	24
Woodward Bros. & Copelin, Ltd.	24
Zimmermann Engineering Works, Gustav	—

August's



The No. 3 Simpson Mixer fitted with Air Operated Double Discharge Gates.

The Simpson Intensive Foundry Sand Mixer is a machine whose use or popularity is not confined to any one country, but is universal. In every country in the world, where foundries exist, there is found the Simpson Mixer.

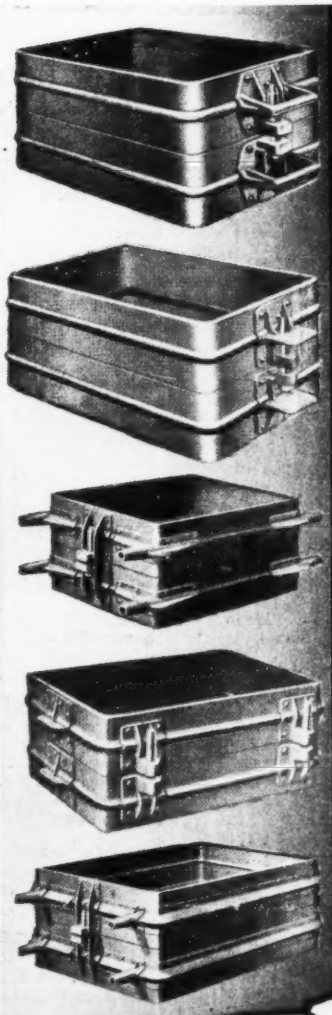
Its universal use throughout the world is due entirely to its remarkable efficiency—it is the very best machine on the market.

It will mix core sand, loam, facing sand and recondition used sand.

It will also mix two damp sands together, and has been doing so for years.

Let us tell you about the Simpson.

AUGUST'S
MUFFLE FURNACES LTD
HALIFAX-YORKS



STERLING FOUNDRY SPECIALTIES LTD. BEDFORD.

LONDON OFFICE —
13, VICTORIA STREET, S.W.1.

TELEPHONE :—
3345 BEDFORD.

TELEGRAMS :—
"STERFLASK, BEDFORD."

.....they play an important part in modern foundry production —— save unnecessary labour, produce accurate castings & reduce your Box Maintenance costs ——

Sterling

SOLID RIBBED ROLLED STEEL

FOUNDRY MOULDING BOXES

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	47	5	0
Three months	46	18	9
Electrolytic	49	0	0
Tough	45	0	0
Best selected	45	10	0
Sheets	80	0	0
India	59	0	0
Wire bars	49	17	6
Do. February	49	17	6
Do. March	49	17	6
Ingot bars	49	17	6
H.C. wire rods	51	0	0
Off. av. cash, November	46	3	8¼
Do., 3 mths. November	46	3	10½
Do., Sttlmnt., November	46	3	1½
Do., Electro, November	49	10	3
Do., B.S., November	48	1	10½
Do., wire bars, November	50	1	3

Solid drawn tubes	11¼d.
Brazed tubes	11½d.
Wire	7¾d.

BRASS.

Solid drawn tubes	10d.
Brazed tubes	12d.
Rods, drawn	9¾d.
Rods, extd. or rlld.	5¾d.
Sheets to 10 w.g.	8¼d.
Wire	8¼d.
Rolled metal	7¾d.
Yellow metal rods	5¾d.
Do. 4 × 4 Squares	6¼d.
Do. 4 × 3 Sheets	6¾d.

TIN.

	£	s.	d.
Standard cash	114	2	6
Three months	115	10	0
English	115	10	0
Bars	115	12	6
Straits	116	15	0
Australian	117	0	0
Eastern	119	2	6
Banca	116	0	0
Off. av. cash, November	113	11	10½
Do., 3 mths., November	114	18	3½
Do., Sttlmt., November	113	11	3

SPELTER.

	£	s.	d.
Ordinary	13	16	3
Remelted	12	0	0
Hard	10	10	0
Electro 99.9	15	10	0
English	13	12	6
India	11	10	0
Zinc dust	20	0	0
Zinc ashes	3	0	0
Off. aver., November	14	19	5½
Aver., spot, November	14	14	1½

LEAD.

	£	s.	d.
Soft foreign ppt.	15	0	0
English	16	10	0
Off. average, November	15	18	7¾
Average spot, November	15	18	8½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	0	0
Do. V.M. ex-whf.	24	0	0
Rods	26	10	0
Boiler plates	19	0	0
Battery plates	19	10	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	25	5	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	7 17 6
45/50%	11 10 0
75%	18 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£15 17 6
Ferro-tungsten—	
80/85%	2/3 lb.
Tungsten metal powder—	
98/99%	2/6 lb.
Ferro-chrome—	
2/4% car.	£30 10 0
4/6% car.	£23 2 6
6/8% car.	£22 0 0
8/10% car.	£21 17 6
Ferro-chrome—	
Max. 2% car.	£32 15 0
Max. 1% car.	£37 12 6
Max. 0.70% car.	£40 12 6
70% carbon-free	10d. lb.
Nickel—99% cubes, or pellets	£175 0 0
Ferro-cobalt	9/6 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0 to £11 10 0
76/80% packed	£12 0 0 to £12 15 0
76/80% export	£10 10 0 to £11 0 0
Metallic manganese—	
94/96% carbonless	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 2
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				2	5	0
Bundled steel and shrngs.				1	15	0
Mixed iron and steel	1	17	6 to	2	0	0
Heavy cast iron	2	5	0 to	2	7	6
Good machinery for foundries				2	7	6
Cleveland—						
Heavy steel				2	6	0
Steel turnings				1	15	0
Cast-iron borings				1	10	0
Heavy forge				3	2	6
W.I. piling scrap				2	17	6
Cast-iron scrap	2	10	0 to	2	12	6
Midlands—						
Ord.cast-iron scrap				2	5	0
Heavy wrought				3	0	0
Steel turnings	0	17	6 to	1	0	0
Scotland—						
Heavy steel				2	7	6
Ordinary cast iron				2	11	3
Engineers' turnings				1	13	9
Cast-iron borings				1	15	0
Wrought-iron piling				3	0	0
Heavy machinery				2	15	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	36	0	0
Brass	29	0	0
Lead (less usual draft)	13	10	0
Tea lead	10	0	0
Zinc	7	10	0
New aluminium cuttings	50	0	0
Braziery copper	33	0	0
Gunmetal	36	0	0
Hollow pewter	80	0	0
Shaped black pewter	60	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	66/-
Foundry No. 3	63/6
Foundry No. 4	62/6
Forge No. 4	62/-
Hematite No. 1	71/-
Hematite M/Nos.	70/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/-
„ d/d Birm.	88/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	66/-
„ No. 3 fdry.*	71/-
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
Derbyshire forge*	66/-
„ fdry. No. 3*	71/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	79/-
„ No. 3	76/6
Hem. M/Nos.	76/-
Sheffield (d/d district)—	
Derby forge	61/-
„ fdry. No. 3	66/-
Lincs. forge	—
„ fdry. No. 3	66/-
E.C. hematite	83/6
W.C. hematite	86/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs foundry No. 3	69/6
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	90/6 to 91/-
Glengarnock, No. 3	—
Eglinton, No. 3	90/6 to 91/-
Gartsherrie, No. 3	90/6 to 91/-
Monkland, No. 3	90/6 to 91/-
Shotts, No. 3	90/6 to 91/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	10	0	0 to	10	15	0
Nut and bolt iron	8	15	0 to	9	0	0
Hoops	10	15	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip	10	15	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				14	5	0
Steel—						
Ship plates	8	15	0 to	8	17	6
Boiler plts.	9	7	6 to	10	5	0
Chequer plts.				10	12	6
Angles				8	7	6
Tees				9	7	6
Joists				8	10	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¼ in. (Untested)				7	12	6
				and upwards		
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy				8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	5	0 to	9	10	0
Black sheets, 24g.	8	12	6 to	9	12	6
Galv.cor.shts., 24g.				11	5	0
Galv. fencing wire, 8g. plain				12	0	0
Billets, soft	5	12	6 to	6	5	0
Billets, hard	7	10	0 & up.			
Sheet bars	5	0	0 to	5	12	6
Tin bars	5	0	0 to	5	12	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/0¼
Sheet to 10 w.g.	1/0¾
Wire	1/1¼
Rods	1/0¾
Tubes	1/5½
Castings	1/0¼

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	14.00
Basic	18.76
Bessemer	19.26
Malleable	19.26
Grey forge	18.26
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	31.00
Sheet bars	31.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.90
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.95
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.30
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	25/- to 27/6
„ furnace	16/- to 18/-
Durham and Northumberland—	
„ foundry	15/- to 15/6
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/9
„	28×20 „	31/6
„	20×10 „	23/-
„	18½×14 „	16/6
C.W.	20×14 „	15/-
„	28×20 „	29/6
„	20×10 „	21/-
„	18½×14 „	16/-
Terneplates	28×20	31/- per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars and rods dead soft, steel	£11 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ⅛ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Dec.	17 ..	43	12	6	dec. 12/6
,,	18 ..	45	2	6	inc. 30/–
,,	19 ..	45	10	0	,, 7/6
,,	22 ..	47	5	0	,, 35/–

Electrolytic Copper.

		£	s.	d.		
Dec.	17 ..	46	0	0	dec.	20/–
,,	18 ..	47	12	6	inc.	32/6
,,	19 ..	48	5	0	,,	12/6
,,	22 ..	49	0	0	,,	15/–

Standard Tin (cash).

		£	s.	d.		
Dec.	17 ..	104	10	0	dec.	20/–
,,	18 ..	105	17	6	inc.	27/6
,,	19 ..	105	15	0	dec.	2/6
,,	22 ..	114	2	6	inc.	167/6

Tin (English ingots).

		£	s.	d.		
Dec.	17 ..	105	12	6	dec.	17/6
,,	18 ..	107	0	0	inc.	27/6
,,	19 ..	106	17	6	dec.	2/6
,,	22 ..	115	10	0	inc.	172/6

Zinc Sheets (English).

		£	s.	d.		
Dec.	17 ..	24	0	0	No	change
,,	18 ..	24	0	0	,,	,,
,,	19 ..	23	0	0	dec.	20/–
,,	22 ..	23	0	0	No	change

Spelter (ordinary).

		£	s.	d.		
Dec.	17 ..	13	5	0	dec.	1/3
,,	18 ..	13	10	0	inc.	5/–
,,	19 ..	13	11	3	,,	1/–
,,	22 ..	13	16	3	,,	5/–

Lead (English).

		£	s.	d.		
Dec.	17 ..	16	0	0	dec.	5/–
,,	18 ..	16	5	0	inc.	5/–
,,	19 ..	16	5	0	No	change
,,	22 ..	16	10	0	inc.	5/–

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1887	37 5	35 10	34 4	34 4	34 1	34 10	34 4	34 5	33 9	31 10	31 8	33 6	34 2
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33 5	34 8	34 2	33 1	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 6
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4½	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	99 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½	90 0	93 10½	117 10	120 0	99 0	86 3
1927	85 0	83 1½	81 0	80 0	73 9	70 0	70 0	68 9	67 6	67 6	66 10½	65 0	73 2½
1928	65 0	65 0	65 6	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	65 9½
1929	66 0	66 9	67 0	68 1½	69 5	71 10½	72 9	72 6	72 6	72 6	72 6	72 6	70 4½
1930	72 6	72 6	70 0	67 6	67 6	67 6	67 6	64 6	63 6	63 6	63 6	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

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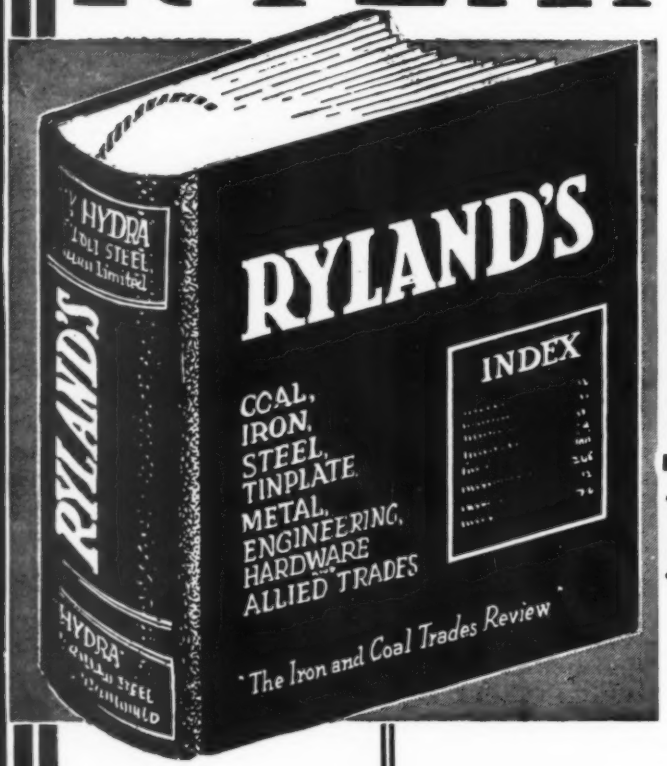

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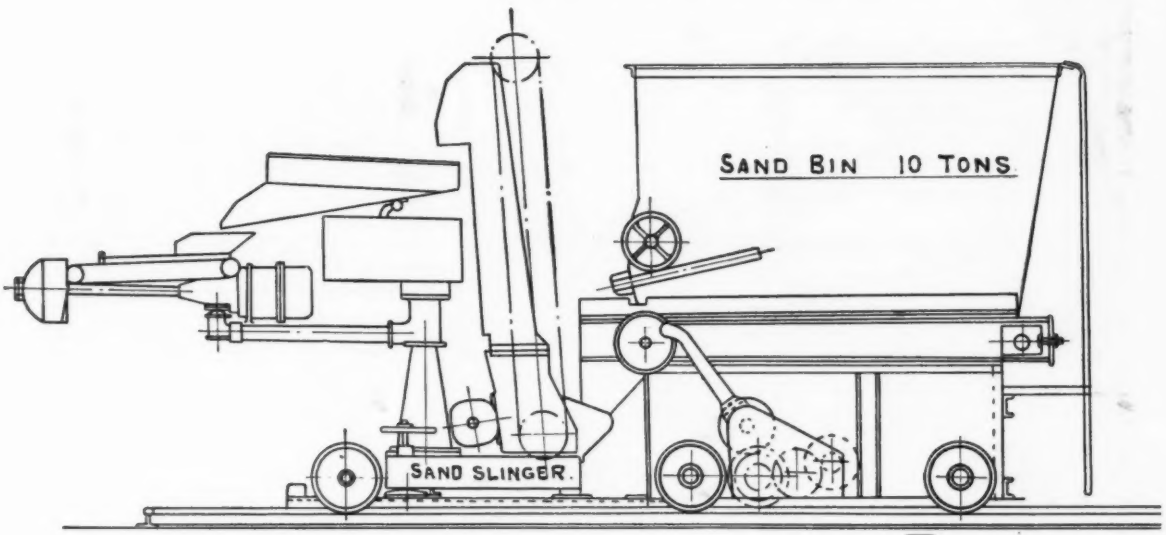

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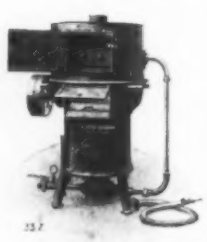

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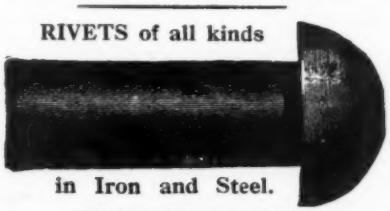

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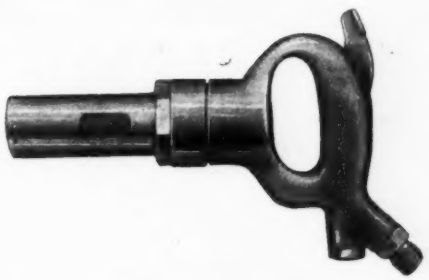

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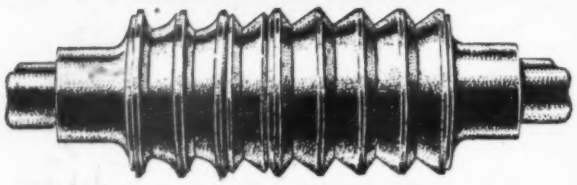

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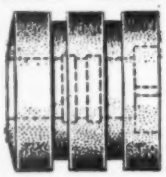
Patent  Process

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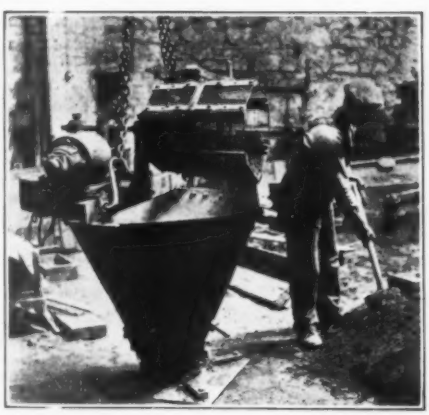

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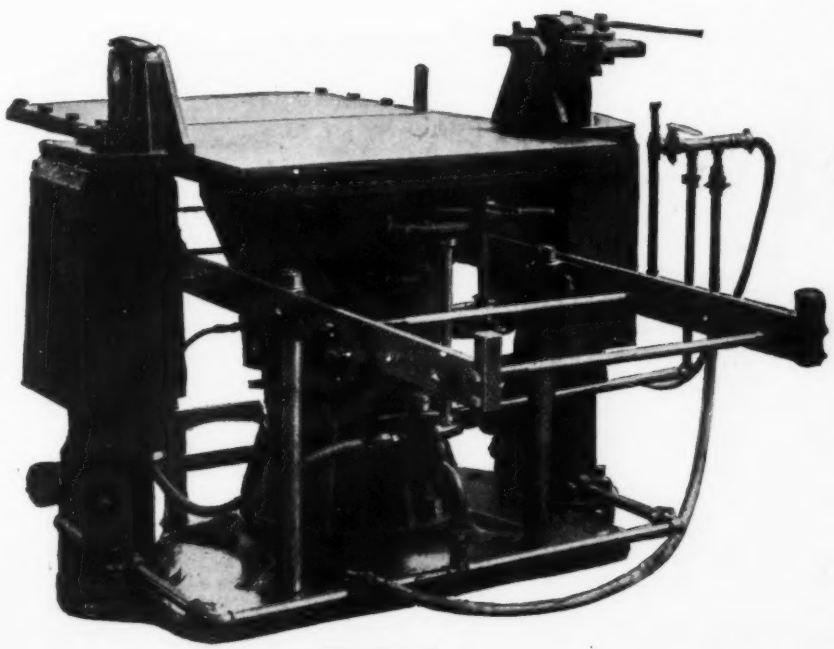

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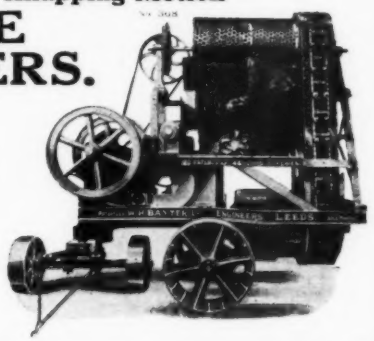

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